SMITHSONIAN INSTITUTION LIBRARIES

SMITHSONIAN INSTITUTION LIBRARIES

THE

RAY SOCIETY.

INSTITUTED MDCCCXLIV.

This Volume is issued to the Subscribers to the Ray Society *for the Year* 1873.

LONDON:

MDCCCLXXIV.

BRITISH MARINE ANNELIDS.

It is intended, on the completion of this Monograph, to issue Title Pages, Tables of Contents, and Lists of the Plates for each volume, and an Index to the whole work. An Index to the species, etc., described in Vol. I is inserted at the end of the present part.

THE

RAY SOCIETY.

INSTITUTED MDCCCXLIV.

This Volume is issued to the Subscribers to the Ray Society *for the Year* 1910.

LONDON:

MCMX.

PRINTED BY ADLARD AND SON, LONDON AND DORKING.

QL
388.4
M15X
V.2 Pt.2
Invert. Zool.

A

MONOGRAPH

OF THE

BRITISH ANNELIDS.

VOL. II.—PART II.

POLYCHÆTA.

SYLLIDÆ TO ARICIIDÆ.

Pages 233—524; Plates LI—LVI, Coloured, and LXXI—LXXXVII, Uncoloured.

BY

WILLIAM CARMICHAEL McINTOSH, M.D.Edin.,

L.R.C.S.E., LL.D., F.R.S., F.R.S.E., F.L.S., C.M.Z.S., V.P. LIT. & PHIL. SOC. St. AND., V.D., etc.

PROFESSOR OF NATURAL HISTORY IN THE UNIVERSITY OF ST. ANDREWS; DIRECTOR OF THE UNIVERSITY MUSEUM AND OF THE GATTY MARINE LABORATORY.

LONDON:

PRINTED FOR THE RAY SOCIETY.

1910.

SMITHSONIAN
MAY 3 1977
LIBRARIES

TEMPORARY PREFACE.

About 70 species are described in the present part (Part II, Vol. II), a smaller number than in the previous part, but the coloration in some is not less beautiful than in those previously depicted.

For the adequate rendering of the coloured plates the Carnegie Trust gave a grant of £200, and the Royal Society £100 for the previous part. I cannot too gratefully acknowledge the liberality and courtesy of both of these important bodies.

To Dr. R. Dohrn of Naples, Dr. Allen of the Plymouth Marine Laboratory, Dr. Goodrich of Oxford, Canon Norman, Dr. Haddon, and Dr. Scharff, I am under obligations for valued aid in connection with specimens; whilst to Mr. Kappel of the Linnean Society, Mr. White of the Royal Society, Mr. Waterhouse of the Zoological Society, Mr. Maitland Anderson and Mr. Smith of the University Library, St. Andrews, and to many fellow-workers in the department, I am equally indebted for aid in connection with the literature of the subject.

I have also to thank Miss Walker for her continued and valued labours with pencil and brush.

Mr. Hopkinson, the Secretary of the Ray Society, has been indefatigable in the correction of proofs, in kindly verifying certain references, and in various ways giving advice and help.

W. C. M.

Gatty Marine Laboratory,
St. Andrews;
September 1*st*, 1910.

FAMILY IX.—SYLLIDÆ, *continued.*

By the careful search of the tidal region at Torquay, Major E. V. Elwes has made a notable addition to the Syllidæ of Britain since the issue of the last part. He followed the plan of immersing roots of tangles and similar growths from the rocks in sea-water, when the Syllids crawl to the water-line and are thus easily removed for examination. Major Elwes kindly forwarded such preparations as he had made, and has thus rendered it possible to include them in the present part. Should living forms be in future obtained they may yet be represented in the work. The success of this observer indicates what may yet be accomplished in the group by skilful and persevering search in suitable localities. Further knowledge of the development of the Syllids has been gained by Mr. Gravely,[1] who found a pelagic stage probably of *Odontosyllis gibba*, off Port Erin, Isle of Man. He also gives an account of three larvæ which he connects with Syllids,[2] his A, B, and C respectively, from the same locality, but further examination would appear to be necessary.

The notice of these also affords an opportunity for reference to the remarkable aberrant form *Ichthyotomus sanguinarius*, found by Lo Bianco on the Neapolitan eel, *Myrus vulgaris*, and ably described and figured by Eisig[3] and referred by him to the Syllids. It is apparently a more modified condition of parasitism than that detailed on p. 140, vol. ii, where a parasitic *Autolytus*, found by C. Crossland at Wasin, East Africa, fixes itself by its permanently extruded proboscis to Nemerteans and Polychæts. *Ichthyotomus* is attached by two stylets to the median fins of the eel, and resembles a broad Syllid, measuring from 5 to 7 mm. in length, or in the case of a ripe female to 10 mm., and having from seventy to eighty segments. The head is round and truncated, with indications of median and lateral tentacles, a minute pair of eyes posteriorly, rudimentary palpi, a ciliated (nuchal ?) groove on each side in front, and a pair of tentacular cirri on the first segment. The body ends posteriorly in a tapered tail with a pygidium, at the tip of which are the anus and two cirri of moderate length. The remarkable boring apparatus recalls the armature in the mastax of certain rotifers, and consists of two twisted blades with serrated edges, sharp points, a "locking" apparatus of the stem, and a posterior bifid process fixed to the complex muscular proboscis in the centre of a cup-like sucker. The proboscis is globular or ovoid, and is followed by a second globular region which Eisig considers to be the

[1] 'Quart. Journ. Micros. Sci.,' N.S., vol. liii, p. 600, 1909.

[2] 'L. M. B. C. Memoirs,' xix, Polych. Larvæ, pp. 4—10, pl. i, figs. 1—5, 1909.

[3] 'Fauna u. Fl. Neapel,' Monographie xxviii, 10 pls., 1906.

homologue of the larval pharynx (dipharyngeal stage), then the stomach and posteriorly the intestine which sends several lobes into the feet. In connection with the pharynx is a pair of "hämophilinen" glands (dorsal and ventral). The nerve-cords are separate, the ganglia being united by commissures. The typical foot has a dorsal cirrus supported by a bristle, and one of the diverticula of the gut enters it, while at the tip is a stylode. Beneath is the setigerous lobe with a spine and compound bristles of two kinds, which vary from front to rear as regards the condition of the tip. The first kind has long, slender, sharp tips which have a homogomph articulation with the shaft; the second kind appears to have in some cases a homogomph and in others a heterogomph articulation with the shaft, the terminal piece being short with a spinous edge and occasionally a joint at the base. A process of the gut also enters this region of the foot. Inferiorly is the ventral cirrus, into the base of which a diverticulum of the gut passes. The segmental organ opens ventrally at its base. Eisig mentions Schmarda's[1] remarkable *Gnathosyllis diplodonta*, which has two bifid stylets in its proboscis, but in many respects it agrees with a typical Syllid like *S. armillaris*. It comes from the Atlantic. The intermediate form is rather to be sought in the parasitic *Autolytus* found by Mr. Crossland, though this does not in any way detract from the interesting and important treatise of Dr. Eisig.

Lately Akira Izuka[2] has found *Trypanosyllis misakiensis* with similar caudal buds to those described by Parlin Johonson. The group, indeed, is remarkable for its budding, phosphorescence, and viviparity, though it is not clearly demonstrated whether the last named is due to parthenogenetic development, or impregnation from without or within. Still more recently Michel, who had made remarks on the diverse types of stolons in Syllids,[3] found a more remarkable condition in *Syllis amica* which presented no less than twelve supplementary heads in successive rings anteriorly, each as a rule having eyes, articulated tentacles, and palps.[4]

Gravier,[5] in his account of the regeneration of the anterior region in the Polychætes, gives various instances of this in the Syllids; *e. g. Ehlersia rosea*, Langerhans, *Syllis gracilis*, Grube, *Typosyllis prolifera*, Krohn, *Syllis alternosetosa*, De St. Joseph, and others.

Genus XLV *A.*—Grubea, *De Quatrefages*, 1865. Char. emend.

Syllids with palpi coalesced almost to the tip, whilst a furrow separates them inferiorly. Proboscis with a single tooth. Preventriculus with follicular walls; short stomach with a pair of glandular cæca; three smooth tentacles; two tentacular cirri. Dorsal cirri smooth, fusiform at the base, attenuate at the apex. Ventral cirri short and tongue-shaped. Bristles compound; tips often bifid. Carry ova on the dorsum or elsewhere.

[1] 'Neue Wirb. Thiere,' ii, p. 69, pl. xxviii, fig. 220.
[2] 'Annot. Zool. Japon.,' vol. v, 1906.
[3] 'Compt. Rend. Acad. Sci.,' cxlviii, p. 365, 1909.
[4] Ibid., p. 438, 1909.
[5] 'Ann. Sc. Nat.,' Zool., 9e sér., t. ix, p. 131, 1909.

GRUBEA CLAVATA, *Claparède*, 1864. Plate LXXXVII, fig. 10—foot; Plate LXXXVI, fig. 11—bristle.

Specific Characters.—Head with three fusiform tentacles, four eyes arranged in a trapezoid and with lenses, a pair of palpi soldered at the base, and two pairs of tentacular cirri, similar in shape to, but longer and larger than the tentacles. Body slightly tapered in front and more so posteriorly, 2—4 mm. in length and of thirty-four bristled segments. Proboscis with a single tooth shaped like the tip of a lance; proventriculus with twenty-two rows of points, and the stomach with two lateral cæca. Tail with two fusiform cirri[1] longer than the ordinary forms. Foot presenting a fusiform dorsal cirrus, a somewhat conical setigerous process with two short clavate papillæ distally, and a short ventral cirrus. Bristles translucent, terminal pieces of moderate length with minutely bifid tips. Ova (eighty to one hundred) borne on the dorsum by a pedicle of the capsule.

SYNONYMS.

1863. *Syllis clavata*, Claparède. Beobacht., p. 41, pl. xii, figs. 28 and 29.
1864. *Sphærosyllis clavata*, idem. Glanures Zoot., p. 90.
1865. *Grubea fusifera*, De Quatrefages. Annel., ii, p. 35, pl. vii, figs. 16—21.
1865. „ *clavata*, idem. Ibid., ii, p. 40.
1868. „ „ Claparède. Annél. Nap., p. 207.
1874. „ *dolichopoda*, Marenzeller. Sitzb. K. Akad. der Wiss. Wien, p. 26, pl. iv, fig. 1.
1879. „ *clavata*, Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxii, p. 564, Taf. xxxii, fig. 21.
1881. „ „ idem. Nova Acta Leop.-Carol. Deutsch. Akad., Bd. xlii, p. 105.
1886. „ „ De St. Joseph. Ann. Sc. Nat., 7e sér., t. i, p. 200, pl. x, figs. 75, 76.
1908. „ „ Elwes. Journ. M. B. A., N.S., vol. viii, p. 197.

Habitat:—A single example from a laminarian root at a low spring-tide at Oddicombe Beach, Torquay (Major E. V. Elwes).

Mediterranean (Claparède); Atlantic, Channel (De Quatrefages, De St. Joseph).

The head is furnished with four eyes, the two anterior being wider apart and with lenses, a median and two lateral tentacles, fusiform at the base and with a tapered tip, and a pair of palpi, which are coalescent and ciliated. The buccal segment bears a pair of tentacular cirri on each side larger and longer than the tentacles, but of similar shape.

The body is almost 3—4 mm. in length, and has thirty-four bristled segments. It is a little tapered at either end, the greater part being of nearly equal breadth. Posteriorly it diminishes to the tail, which has two caudal cirri of similar fusiform shape to, but longer than the dorsal cirri. The proboscis occupies the first five segments, and has a single tooth shaped like the tip of a lance. The proventriculus has twenty-two rows of "points gris," followed by the stomach with two small lateral cæca. The colourless dorsal vessel passes to the left of the proboscis and forms a ring as in *Pædophylax verruger* of Claparède (De St. Joseph).

The foot (Plate LXXXVII, fig. 10) has dorsally the fusiform cirrus with a rather long tip, a conical setigerous region with two clavate papillæ distally, and bearing a series

[1] Langerhans states that there are four short anal cirri.

of translucent bristles with cylindrical shafts and a distinct backward bend at the tip (Plate LXXXVI, fig. 11) which is dilated and bevelled for articulation with the terminal piece, which is of moderate length and has a hook at the tip. A minute secondary process appears beneath it, and the front edge of the terminal piece is probably minutely spinous, though this was not actually seen. Besides these both in the anterior and posterior regions a single simple bristle is present, and the tip of the solitary spine is slightly bent. The ventral cirrus is small and somewhat conical.

In the examples described by De St. Joseph (1886) the body was 2 mm. long, and the number of segments ranged from twenty-seven to thirty-four. Both pairs of eyes had lenses, the anterior being directed to the front, the posterior backward.

Reproduction.—De St. Joseph found the ripe males of a pale orange hue from the sperms, which extended from the tenth to the ante-penultimate segment. The females bore the eggs on the dorsum; and in an example with thirty-one segments there were eighty-six eggs from segments eight to twenty-six, and in another with thirty-four bristled segments four eggs occurred on each segment from the ninth to the twenty-eighth—in all eighty. The eggs are attached by the transparent capsule, and he described the appearance of the advanced embryos. Swimming bristles are absent in all the females.

This species was first found by Claparède (1863) on the coast of Normandy, his largest example having twenty-two segments. He correctly interpreted the structure of the foot, but he did not allude to that of the bristles. The same form he obtained at Port-Vendres next year. De Quatrefages (1865) then described it from the coast of Brittany under the title of *Grubea fusigera*, having constituted the genus *Grubea* for its reception, and he gave a detailed account of its general structure with figures; but he made several misinterpretations which were corrected by Claparède in his 'Annélides de Napoli.'

Langerhans procured the same species at Madeira, and described it as having four anal cirri and bifid tips to the compound bristles.

PIONOSYLLIS[1] LAMELLIGERA, *De St. Joseph*, 1886. Plate LXXXVI, fig. 12—bristle; Plate LXXXVII, fig. 11—foot.

Specific Characters.—Head rounded in front; four eyes with lenses in a trapezoid, and two smaller specks in front; a longer median and two shorter lateral tentacles. Palp large, oblong or ovoid; two tentacular cirri on each side. These and the tentacles in the preparations are moniliform distally. Body slender, little tapered anteriorly, but distinctly so posteriorly, where there are two anal cirri. Length 6—7 mm., and segments forty-five to fifty-five. Translucent, marked by three violet bars on the dorsum of each segment. The proboscis has ten soft papillæ and a large tooth anteriorly. Proventriculus with twenty-two to twenty-five rows of points. Foot has dorsally a moderately long smooth cirrus; setigerous region bluntly conical, with translucent compound bristles, the upper series of which has long tips, the lower considerably shorter, and all are bifid, and thus somewhat approaching *Syllis cornuta*, H. R. Ventral cirrus tongue-shaped. Reproduction direct; male of rose-orange hue when ripe; female has grey or violet eggs (De St. Joseph).

[1] See p. 161.

Synonyms.

1886. *Pionosyllis lamelligera,* De St. Joseph. Ann. Sc. Nat., 7e sér., t. i, p. 163, pl. viii, figs. 30—38.
1908. „ „ Elwes. Journ. M. B. A., n.s., vol. viii, p. 198.

Habitat.—Common amongst Laminarian roots between tide-marks at Torquay (Elwes). Between tide-marks at Dinard, France (De St. Joseph).

Head rounded in front with four eyes in a trapezoid, the anterior pair the larger and wider apart, and all furnished with lenses. Besides, a pair of smaller black specks occur near the anterior border. Three tentacles, a longer median, and two shorter lateral, are attached to the head, and whilst the basal region of each is smooth, the distal is moniliform, a result to some extent of the mode of preparation. In life De St. Joseph found them hirsute with palpocils. The palpi are large, oblong in life (De St. Joseph), but ovoid in the preparations, soldered at the base (De St. Joseph), though in the preparations this could not be made out. The buccal segment is separated from the head by a brown bar, and on each side are two tentacular cirri, a longer dorsal and shorter ventral.

The slender *body* is very little tapered anteriorly, but posteriorly it gradually diminishes to a slender tail which has two anal cirri. The length is 6—7 mm., and the number of bristled segments varies from forty-five to fifty-five, the anterior being less distinctly separated than the posterior. It is more or less translucent, marked by three violet bars on the dorsum of each segment (De St. Joseph).

The proboscis has ten soft papillæ anteriorly, and a large tooth. The proventriculus has from twenty-two to twenty-five rows of points, and the stomach follows with two lateral pouches. Abutting on the anterior circle of papillæ in the proboscis is on each side a glandular tube, enlarged into a sac on reaching the level of the proventriculus, and filled with little "pits" like those in *Eusyllis* (De St. Joseph).

The foot (Plate LXXXVII, fig. 11) presents dorsally a moderately long cirrus, which, though slightly crenate distally, does not present in the preparations the moniliform condition of the cephalic and buccal appendages. The setigerous process is bluntly conical, and bears a series of rather small translucent compound bristles, the tips of which vary from the inferior series with short bifid tips to those at the dorsal edge of the fascicle with much longer and apparently minutely bifid tips (Plate LXXXVI, fig. 12). The condition is thus parallel with that in the *Syllis cornuta* of H. Rathke, though none of the shorter series in the latter corresponds with the structure in *Pionosyllis lamelligera.* Moreover the spines are much stouter in *S. cornuta*, and have not the modification of the tip indicated by De St. Joseph, though it cannot be said that this condition has actually been seen in the mounted examples. The ventral cirrus is a somewhat lanceolate structure with large hypodermic reticulations.

Reproduction.—De St. Joseph mentions that reproduction is direct, and that when the sexual elements are ripening the four posterior eyes increase sensibly in size. In the female grey or violet eggs appear from the fifth or sixth to the ninth segment from the posterior end. All the segments bear swimming bristles, and the intestine atrophies. Similar changes occur in the male; only those segments filled with sperms have a trapezoidal form and a rose-orange hue. There are eighteen pairs of brownish testes (De St. Joseph).

Pionosyllis alternosetosa, *De St. Joseph*, 1886. Plate LXXXVI, fig. 15—bristle; Plate LXXXVII, fig. 12—foot.

Specific Characters.—Head generally as in *P. prolifera*, but sometimes with an additional pair of eye-specks in front. Median tentacle with twenty, the lateral with fifteen, and the longest tentacular cirrus with twenty articulations. Body somewhat roseate with madder-brown or roseate transverse bands in front; 15—28 mm. in length and with 110—144 segments, the latter having a stolon of thirty-two segments (De St. Joseph). Anal cirri with twenty articulations, and a median pygidial papilla. Foot with a moniliform dorsal cirrus of twelve segments. Setigerous process carries compound bristles, the bifid tips of which are of moderate length anteriorly and posteriorly, but are shorter in the central region and may have neither spinous edge nor secondary process, which is minute and slants forward, as if a stouter spike at the end of the spinous row. Ventral cirrus somewhat fusiform in outline, the tip less tapered than in *P. prolifera*, with which the ten soft papillæ in front of the proboscis and the large single tooth agree.

Synonyms.

1886. *Syllis* (*Typosyllis*, Lang.) *alternosetosa*, De St. Joseph. Ann. Sc. Nat., 7e sér., t. i, p. 150.
1904. *Typosyllis alternosetosa*, Allen. Journ. M. B. A., n.s., vol. vii, p. 219.
1908. *Syllis alternosetosa*, Elwes. Ibid., vol. viii, p. 199.

Habitat.—Eddystone Grounds, Plymouth (Allen); Torquay, between tide-marks (Elwes).

Dinard, coast of France (De St. Joseph).

In 1886 De St. Joseph described, under the name of *Syllis* (*Typosyllis*, Lang.) *alternosetosa*, a new species which he had found extremely common both in dredgings and between tide-marks at Dinard. Major Elwes met with the same form in considerable abundance at Torquay, and to his kind courtesy in forwarding mounted specimens the present remarks are due.

This Syllid bears in size, external appearance, and coloration a near resemblance to *Pionosyllis prolifera*, Krohn; and as this widely distributed form shows very considerable variation, both in coloration and the length of the cirri, there is room for re-consideration, especially as Malaquin considers *P. alternosetosa* identical with *S. hyalina*, Grube, whilst Giard thinks it is a variety of *Syllis cornuta*, H. Rathke. The head in these examples closely resembles that of *Pionosyllis prolifera*, though differing in having an extra pigment-spot in front and shorter tentacles. The median tentacle has about twenty articulations, the lateral fifteen, and the longest tentacular cirrus twenty. The dorsal cirri have about twelve articulations, the anal cirri twenty, and between them is an unpaired median papilla, as in *P. prolifera*, the papilla in the latter occasionally being bifid, as an abnormality. The cirri and tentacles certainly differ considerably in character, those of *P. alternosetosa* being shorter and even more distinctly articulated. They are proportionally thicker, and taper more abruptly. In the structure of the foot (Plate LXXXVII, fig. 12) the ventral cirri of the two forms diverge, for whilst that of *P. prolifera* has a tendency to be subulate, that of *P. alternosetosa* has a tip less tapered,

and a tendency to enlargement in the middle (according to the preparations), so that it is somewhat fusiform, for it is narrowed at the base. It more nearly resembles the ventral cirrus of *Pionosyllis hyalina* than that of *P. prolifera*. The proboscis, again, agrees in structure with that in the latter form, having ten soft papillæ in front, and a single large tooth.

De St. Joseph distinguishes the form thus: "Caractère distinctif.—Soies composées à serpe bidentée dans les segments antérieurs, faisant place à des soies composées à serpe unidentée dans les segments postérieurs nietées à celles-ci." The examples from Torquay show a general resemblance externally to *Pionosyllis prolifera*, whilst a scrutiny of the bristles from front to rear demonstrates that the tips of the compound bristles (Plate LXXXVI, fig. 13) become somewhat shorter at the eighteenth or nineteenth segment and for a considerable distance thereafter, but no abrupt change is noticeable. The secondary process, which is minute, has the aspect of a stouter spike terminating the spinigerous edge of the terminal piece, and therefore is subject to the same influences which affect the latter. The spines from the edge of the terminal piece are generally absent in the middle region of the body, but in almost every foot a secondary process or a trace of it can be detected in one or more bristles from the anterior to the posterior region of the body, where this process is again evident. Thus in all probability the normal condition is to have a secondary process or stouter spike terminating the row along the edge, but with the removal of the latter, by friction or otherwise, the secondary process likewise often disappears. Moreover, in a male stolon, the secondary process of the compound bristles could be observed in almost every bristle in each foot from front to rear, and it has to be borne in mind that the secondary process is minute and by no means easily seen in any case. It would also be exceptional in the Syllids for a compound bristle with a bifid tip to lose, without external influences, the secondary process after eighteen or twenty segments so as to become simply hooked, and again to become bifid posteriorly. The view that friction in the intermediate region removes the spines and the secondary process, therefore requires consideration, especially as the bifid tips are more numerous in the middle region of the stolon.

In comparing allied forms it is observed that in *Pionosyllis hyalina* the secondary process of the tip of the compound bristle more resembles that in *P. prolifera* than in *P. alternosetosa*. The same process is also nearer the tip in *Syllis cornuta*, H. Rathke, in which the tips of the bristles on the dorsal edge of the fascicle are much longer. The tip in *P. alternosetosa* has a different character from that of *P. prolifera*, where the secondary process is stronger, and the spinous edge seems to be less liable to injury. It may be a question whether this secondary process represents the last of the spines on the edge or a special development, but it has not the individuality seen in most forms. The imperfection in figures renders it difficult to be precise as to the relationship stated by De St. Joseph to exist between it and *Syllis solida*, Grube,[1] but the latter has longer dorsal cirri.

[1] 'Annul. Semper.,' p. 120, Taf. vi, fig. 7.

TRYPANOSYLLIS[1] CÆLIACA, *Claparède*, 1868. Plate LXXXVI, fig. 14—bristle; Plate LXXXVII, fig. 3—foot.

Specific Characters.—Head somewhat small, transversely elongated in the preparation, with four distinct eyes arranged in a trapezoid, the anterior pair being wider apart. The median and two lateral tentacles are short, and in the preserved specimen have only six articulations (nine to eleven, De St. Joseph). Palpi somewhat ovoid. Tentacular cirri short; dorsal with ten and the ventral with six articulations. Body in preservation rather thick, slightly tapered in front, more distinctly so posteriorly, and with two caudal cirri of seven articulations, the distal being the largest. Colour a deep yellow. Length 8—12 mm., and segments seventy to ninety (De St. Joseph), the British forms being smaller. Proboscis has ten denticulations in front; proventriculus has twenty to twenty-five rows of points. Stomach with a pair of large yellow cæca. Foot has dorsally a cirrus of seven to eight segments, the thickest part in the preparations being a little above the base, so that the organs are fusiform. Setigerous region a blunt cone with a single spine and a fascicle of compound bristles with rather short and boldly bifid tips. Ventral cirrus comparatively large and lanceolate. Reproduction by stolons.

SYNONYMS.

1868. *Trypanosyllis cæliaca,* Claparède. Annél. Nap., p. 203, pl. xiii, fig. 3.
1875. ,, ,, Marion and Bobretzky. Ann. Sc. Nat., 6e sér., t. ii, p. 37, pl. xiii, fig. 3.
1879. ,, ,, Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxii, p. 557.
1886. ,, ,, De St. Joseph. Ann. Sc. Nat., 7e sér., t. i, p. 184, pl. ix, figs. 57—63.
1908. ,, ,, Elwes. Journ. M. B. A., N.S., vol. viii, p. 201.

Habitat.—Oddicombe rocks, Torquay, between tide-marks (Major Elwes).

Port Vendres (Claparède); Marseilles (Marion and Bobretzky); Madeira (Langerhans); Dinard, France (De St. Joseph).

Head somewhat small, transversely elongated, and with four distinct eyes arranged in a trapezoid, the anterior pair being wider apart. The median and two lateral tentacles are short, and in the preserved specimen have only six articulations, the terminal being the largest, so that each is somewhat clavate. The palpi are ovoid. The tentacular cirri are likewise short, the dorsal having nine and the ventral six divisions.

The body, when preserved, is rather thick, slightly tapered in front, but more distinctly so posteriorly, and with two caudal cirri of about seven articulations, the distal, as in the case of the tentacles, being the largest. The colour is of a deep yellow, and thus it is in contrast with the French examples of *Trypanosyllis Krohnii*. De St. Joseph gives the number of segments as seventy to ninety. The proboscis has ten soft papillæ and ten teeth in front. It occupies segments three to eleven. The proventriculus has twenty to twenty-five rows of points. The stomach which follows has a pair of large cæca of a yellow colour. De St. Joseph states that he found air in these cæca as in other forms. Claparède considered that the intestine was prolonged in front of the latter in the form of cæca, but De St. Joseph shows that this is only apparent.

[1] See p. 169.

The typical foot (Plate LXXXVII, fig. 13) has dorsally a short cirrus of about seven or eight segments, the thickest part in the preparations being a little above the base, so that the organ is somewhat fusiform. The setigerous process forms a blunt cone supported by a single strong spine and a fascicle of bristles having the distal ends of the shafts enlarged, curved backward, and bevelled for the terminal piece (Plate LXXXVI, fig. 14) which is rather short and boldly bifid, the front edge, moreover, being minutely spinous. The ventral cirrus is comparatively large and lanceolate.

Claparède first procured this species at Port-Vendres, and distinguished it from *S. Krohnii* by the difference in coloration, though it resembles it in size, and in the shortness of its tentacles and cirri. He noted especially the prolongation of the intestine forward in front of the proventriculus, and its remarkably moniliform character.

De St. Joseph found the species propagating in July by stolons which have the form of *Tetraglene*. The nurse-stock is of a deep yellow and the stolon of a fine rose-colour, the former consisting of thirty-five to forty-four segments, and the latter (female) of thirty-five to forty-one with natatory bristles. As exceptions he has seen a nurse-stock of only fifteen setigerous segments without proboscis, proventriculus, or stomach, and a stolon of thirty-seven segments without swimming bristles. The male stolon with natatory bristles may have thirty-five to thirty-nine segments with testes from the second or third to the third or fifth from the posterior end. Its head is less deeply cleft, the feet less elongated, the body less massive, and the coloration of a deeper rose-colour than in the male of *T. Krohnii*.

Genus LIV *A*.—Eurysyllis,[1] *Ehlers*, 1864.

Head large, fused dorsally with the first segment, without palpi, bearing anteriorly three flattened processes; four eyes. First segment undifferentiated dorsally, without a foot, but with two stumpy tentacular cirri, the basal process being cylindrical and the terminal ovoid or almost globular, and the cirri which follow have a similar shape. The body is comparatively broad.

Eurysyllis paradoxa, *Claparède*, 1864. Plate LXXXVI, fig. 15—bristle; Plate LXXXVII, fig. 3—head, and fig. 14—foot.

Specific Characters.—Head small, transversely elongated, with two lateral processes anteriorly. Eyes four, reddish, furnished with lenses, and occasionally an additional pair of specks in front. The median tentacle is a broad, flattened truncate process, and the lateral are rounded flattened processes. The palpi are flattened and ovoid. Two short tentacular cirri, the cirrus being globular and attached to a basal ceratophore. The ventral is considerably shorter than the dorsal. Body comparatively short and broad, resembling *Sphærosyllis*, slightly tapered anteriorly and more so posteriorly, and ending in two globular anal cirri with an intermediate point. Bristled segments about fifty-seven, and the length 3—4 mm. Proboscis preceded by six large papillæ and with ten denticles on its anterior edge; proventriculus short and ovoid, narrower in front; stomach without

[1] Εὐρύς, broad, and *Syllis*.

lateral cæca. The foot has a more or less globular dorsal cirrus with a basal cirrophore, a short conical setigerous region with translucent bristles, with an enlarged distal end to the shaft and a bevelled region with a very acute point. The terminal piece of the bristle has a simple hook at the tip. Ventral cirrus lanceolate, soldered at the base to the foot. Reproduction by stolons.

Synonyms.

1864. *Polymastus paradoxus*, Claparède. Glanures Zoot., p. 109, pl. viii, fig. 3.
1864. *Eurysyllis tuberculata*, Ehlers. Borstenw., i, p. 264, Taf. xi, figs. 4—7.
1870. ,, *paradoxa*, Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxii, p. 574, pl. xxxii, fig. 27.
1886. ,, (*Polymastus*) *paradoxa*, De St. Joseph. Ann. Sc. Nat., 7e sér., t. i, p. 191, pl. ix, figs. 68—74.
1908. ,, ,, ,, Elwes. Journ. M. B. A., n.s., vol. viii, p. 201.

Habitat.—Between tide-marks at Oddicombe Rocks, near Torquay (Elwes).

Mediterranean (Claparède); Atlantic (Langerhans); Dinard, France, on dredged shells at a depth of 10—25 mètres, and on *Rytiphlœa pinastroides* from a depth of 4—7 mètres (De St. Joseph).

Head (Plate LXXXVII, fig. 3) comparatively small, transversely elongated, and having two lateral processes anteriorly, the anterior eyes being at the base of these or even on them, as Ehlers shows, with four reddish eyes furnished with lenses, and De St. Joseph describes an additional pair of pigment-specks in front. The median tentacle is a broad truncate process, and the two rounded lateral flattened processes represent the lateral tentacles. The palpi form two flattened and somewhat ovoid processes on the ventral surface, their tips only projecting forward in a dorsal view. The tentacular cirri are two; the dorsal have a globular tip articulated to a basal ceratophore. A shorter adnate process of similar shape ventrally represents the ventral cirrus.

The body is comparatively short and broad as in *Sphærosyllis*, a little tapered anteriorly before reaching the truncate frontal border, and also slightly tapered posteriorly to the two globular anal cirri with a point attached. The bristled segments are about fifty-seven, so that the British examples approach those from the French coast, which have in all sixty-five segments. The colour is reddish or greyish-red. The feet form a somewhat even and regular series from end to end, the dorsal cirri, however, being globular in front and somewhat more elongated posteriorly so as to make a greater proportional difference between their breadth and that of the cirrophore in this region. Moreover, in a form with a reproduced tail these organs and the anal cirri have a tendency to greater elongation than in the ordinary form. Each segment has four tubercles, the buccal alone having two, and these agree in structure with those on the feet.

The proboscis has ten minute points on the edge anteriorly, besides a large dorsal tooth, preceded by six large papillæ (De St. Joseph). The proventriculus is short and almost ovoid in outline and slightly narrower in front, and the stomach has no lateral cæca. The reddish intestine has lateral processes which De St. Joseph thinks contain air as in *Trypanosyllis*.

The foot (Plate LXXXVII, fig. 14) has dorsally the cirrus with its basal cirrophore

and its rounded or ovoid distal region containing, as De St. Joseph points out, yellowish corpuscles and rod-like bodies or bacilli ("bâtonnets," De St. Joseph). The setigerous region forms a short cone with the lanceolate ventral cirrus soldered to it, the tip alone being free. The bristles are translucent, with shafts slightly curved at the tip, the bevelled region having an acute tip, and the terminal piece is comparatively short (Plate LXXXVI, fig. 14) and has a simple hooked tip. The single rather strong spine supporting the setigerous region has a mucro at the tip. In the posterior segments De St. Joseph found a simple bristle with a curved point.

Reproduction.—This was unknown to the earlier observers, but De St. Joseph found that it showed the so-called alternation of generations. Thus in one form of sixty-five segments, thirty-eight of the anterior are devoid of eggs, but the twenty-four following have them, whilst the last three are free from them. The violet, green, brown, or dark red female buds have the same dorsal tubercles as the nurse-stock, four eyes, of which two are inferior, are devoid of proboscis, proventriculus, and stomach, but have a rudiment of intestine. The feet possess bristles and a spine like the adult, but in addition the annelid has long swimming bristles. The male buds are pale rose-orange, with brown testes from the third to the fourteenth. De St. Joseph further notes that the two segments of the nurse-stock in front of the head of the bud are often full of ova or sperms.

Eurysyllis paradoxa was introduced to science (1864) by the indefatigable Claparède, who, in spite of delicate health, did so much for the marine Annelids. He found it at Port-Vendres, and described it under the name of *Polymastus paradoxus*, giving fairly good figures of its general structure. He regarded the dorsal processes as homologous with those of *Ephesia*, and he figured the compound bristles with simple tips.

Simultaneously (1864) with Claparède, Ehlers gave an account of a new genus and species—*Eurysyllis tuberculata*—which he procured at Quarnero in the Adriatic. He also alluded to the pinnate intestine, and described the compound bristles as having simple tips, and the tips of the spines as furnished with a knob. So far as can be observed this form would appear to be the same as Claparède's.

Langerhans next (1879) met with it between tide-marks at Madeira, and he agrees with the preceding authors in the structure of the tip of the terminal piece of the compound bristles. To the spine he gave a clavate tip with a central process.

AUTOLYTUS[1] EHBIENSIS, *De St. Joseph*, 1886. Plate LXXXVI, fig. 16—bristle; Plate LXXXVII, fig. 15—foot.

Specific Characters.—Head rounded in front with four eyes having lenses posteriorly and arranged in a trapezoid, the anterior pair being wider apart. Tentacles normal, the median being much longer than the lateral, and the dorsal tentacular cirrus fully as long. The dorsal tentacular cirrus is the longest appendage. Body of the nurse-stock greyish, slightly flattened dorsally and ventrally, generally has a series (one to seven) of buds, and much resembles *Autolytus prolifer*. Proboscis firm, sinuous and narrow, with thirty minute teeth on its front edge, though a form with twenty is identical

[1] See p. 209.

(De St. Joseph). Proventriculus with thirty-two to forty-two rows of points, barrel-shaped. Foot has dorsally a longer or shorter cirrus (for they appear to be more or less alternate). Setigerous lobe is fused with a large globular mass behind it, perhaps representing a modified ventral cirrus. It bears a group of translucent compound bristles of the usual shape, the terminal piece being boldly bifid. Reproduction by stolons, and it is rarely without one or more.

Synonyms.

1886. *Autolytus ehbiensis,* De St. Joseph. Ann. Sc. Nat., 7e sér., t. i, p. 228, pl. xi, figs. 106, 107; pl. xii, figs. 114, 115.

1908. „ „ Elwes. Journ. M. B. A., n.s., vol. viii, p. 201.

Habitat.—On Fucus covered with *Sertularia pumila* growing on the breakwater at Babbacombe (Elwes).

On the shores of Dinard, France, it occurs at some depth off the coast, as well as between tide-marks, amidst the forests of *Sertularia operculata*, accompanied by swarms of *Caprella linearis* (De St. Joseph).

The head is rounded in front, with four eyes arranged in a trapezoid posteriorly, the anterior pair wider apart, and all with lenses. The median is much longer than the lateral tentacles, and the dorsal of the tentacular cirri is fully as long. The palpi are not visible, and De St. Joseph states that they are small.

The body of the nurse-stock, which is slightly flattened dorsally and ventrally, generally has a series of buds attached to it; indeed De St. Joseph never found it without a bud, whilst Major Elwes met with only two or three out of fifty or sixty examples without one. It has the form of *Autolytus prolifer*, and has quite as remarkable a furor for budding. According to the last-mentioned author, chains of five or six buds are common. In the nurse-stock the dorsal cirrus of the first bristled segment is the longest, the next longer than the succeeding, whilst the rest appear to have an alternate arrangement of long and short, the two caudal cirri being considerably longer.

The proboscis is firm, convoluted and narrow, with about thirty minute sharp points on its anterior end. As, however, De St. Joseph records an example not distinguishable from this species, with only twenty minute teeth, there would seem to be a considerable margin for variation. The proventriculus has from thirty-two to forty-two rows of points, and is somewhat barrel-shaped, slightly narrowed at each end.

The foot (Plate LXXXVII, fig. 15 in the nurse-stock) has dorsally the longer or the shorter cirrus; the former, to judge from the preparations, may reach the diameter of the body. The setigerous region is fused with a large globular mass behind it, and perhaps represents a modified ventral cirrus, and bears a series of translucent bristles (Plate LXXXVI, fig. 16) with the ends of the shaft enlarged and bevelled for the terminal piece, which is very boldly bifid as in the typical *Autolytus*.

De St. Joseph found *Ophryodendron annulatorum* parasitic on the tentacular cirri.

Reproduction.—This species reproduces by a male or female stolon, or by a chain of stolons. According to De St. Joseph if a single stolon is found, the bristle with "article en alnĉe" appears on the sixth segment, whereas it occurs on the fifteenth segment where there is a chain of stolons. Moreover, in the case of a single bud, which is

produced between the last and the penultimate segment, these segments show no trace of sexual elements. After it separates the nurse-stock regenerates the posterior end and the caudal cirri. In the best-developed bud a single simple bristle accompanies the compound.

The ripe buds agree with those of *Autolytus prolifer*, having a head with a frontal notch, three tentacles, and four eyes furnished with lenses, the ventral pair being larger than the dorsal. The first segment of the body has two tentacular cirri, and in a female bud (De St. Joseph) eighteen segments follow, sixteen of which have large grey eggs. All the segments except the first two and the last two have swimming bristles. In the first a simple bristle, "à l'article en alêne," is amongst the falcigerous forms. After they are detached they acquire twenty-five segments, the swimming bristles are shed, and an ovigerous pouch containing about three hundred embryos of the stage described by Max Müller with small eyes and cilia is found.

The description of the male bud as given by De St. Joseph does not seem to differ from that of *A. prolifer*. The same author gives an account of nurse-stocks of thirty-eight and twenty-seven segments, with buds varying in degree of development, in the latter case a region without bristles following the nurse-stock; then a bud of twelve segments without a head; a second of seventeen segments with the head indicated; a third of twenty-one segments with four eyes, three tentacles, and traces of eggs; a fourth of twenty-five segments with the head well developed and advanced eggs; a fifth bud of nineteen segments with large head and eggs; and a sixth and last bud of twenty segments with large eggs and natatory bristles, twisting its body with energy in order to detach itself. Each bud had a rudimentary intestine and compound bristles, but the last only had the natatory bristles. Only a single fully formed male bud (*Polybostrichus*) of twenty-one segments was seen attached to a nurse-stock of thirty-six segments. He found a nurse-stock with seven male buds without swimming bristles, and only the last showed sexual elements.

One example forwarded by Major Elwes had seven buds, the first having only a pair of lateral processes posteriorly. The second had no bristles, and the third a few in front.

Autolytus longiferiens, *De St. Joseph*, 1886. Plate LXXXVI, fig. 17—bristle; Plate LXXXVII, fig. 16—foot.

Specific Characters.—Head fairly large; four considerable eyes with lenses. Central much longer than the lateral tentacles. A median line indicates the palpi. Tentacular and first dorsal cirri as in *A. ehbiensis*. Body rather massive, from 10—20 mm. in length, and having from fifty-one to eighty-eight segments. Dorsal cirri of moderate length and alternately long and short. Posteriorly are two long and large caudal cirri. General colour orange, with three longitudinal reddish bands, the two lateral forming "epaulettes" in the first two segments. Proboscis remarkable for its great length, coiled condition, and slenderness, as well as for its crown of ten large, obtuse teeth, and its intermediate series of two or three smaller pointed teeth, which have two spines

posteriorly (De St. Joseph). Proventriculus reddish-orange, rather long, barrel-shaped, and narrower anteriorly. It has forty to fifty-four rows of points (De St. Joseph). Foot with a longer or shorter, slightly tapered, dorsal cirrus, a rather massive setigerous process soldered to the rounded posterior mass, and bearing a series of somewhat short bristles, which have short, deeply bifid terminal pieces, the base in front being so narrow as to resemble a third tooth. Spine with a small mucro, and a single bristle with a short delicately tapered tip is present.

Reproduction by stolons (De St. Joseph).

Synonyms.

1886. *Autolytus longiferiens*, De St. Joseph. Ann. Sc. Nat., 7e sér., t. i, p. 217, pl. x, figs. 95—97.
1908. „ „ Elwes. Journ. M. B. A., n.s., vol. viii, p. 202.

Habitat.—Between tide-marks, Oddicombe, Torquay (Major Elwes).

Common in dredged material at Dinard, coast of France (De St. Joseph).

Head fairly large; four distinct eyes with lenses. The median and lateral tentacles have the usual proportions. A central line indicates the palpi anteriorly. The tentacular cirri are also normal, whilst the dorsal cirrus of the first bristled segment agrees with that of *A. ehbiensis* in being the longest appendage of the kind.

Body rather massive, from 10—20 mm. in length, and having from fifty-one to eighty-eight segments (De St. Joseph), the British examples so far as observed being intermediate in size. The dorsal cirri are of moderate length, and long and short alternately, a condition met with in other forms; but, as De St. Joseph points out, the relatively greater length of the anterior cirri is noteworthy, and the dorsal cirrus of the fifth segment is longer than the third, whereas in *Procerœa* it is small (De St. Joseph). Unfortunately the examples do not afford information on these points. Posteriorly the body terminates in two long and large caudal cirri. The general colour is orange. In front of the proventriculus are three longitudinal reddish bands, the two lateral forming "epaulettes" in the first two segments.

The proboscis is remarkable for its great length, coiled condition, and slenderness, as well as for the fact that its anterior edge has a crown of ten large obtuse teeth separated by three smaller pointed teeth which terminate posteriorly in two spines (De St. Joseph). Major Elwes, however, notes that the British examples have only two of the intermediate smaller teeth instead of three, and this appears to be right; but the French examples are much larger, for the proboscis, instead of being only 2 mm. (Elwes), is from 18—20 mm. (De St. Joseph) in length. The latter author agrees with Claparède[1] in defining three regions of the organ, the anterior the most muscular. The reddish-orange proventriculus is rather long and barrel-shaped, narrower anteriorly than posteriorly, and has from forty to fifty-four rows of points (De St. Joseph).

The typical foot (Plate LXXXVII, fig. 16) has dorsally the long and slightly tapered smooth cirrus (long or short), a rather massive setigerous region soldered to the rounded posterior mass, and bearing a group of somewhat short compound bristles which have very short bifid terminal pieces (Plate LXXXVI, fig. 17), the curve from the second

[1] 'Annél. Nap.,' p. 218.

process running to the base, which is thus pointed, giving a pseudo-trifid aspect to the terminal piece. The distal end of the shaft of the compound bristles is minutely spinous along both edges. The spine has a terminal mucro, and a single bristle with a pointed terminal piece is present.

Reproduction.—De St. Joseph observed specimens without swimming bristles carrying greyish ova behind the proventriculus, but he has rarely seen buds, though two short examples with reproduced posterior ends may indicate this condition, and indeed in one specimen of fifty-one segments a bud began at the forty-first.

AUTOLYTUS INERMIS, *De St. Joseph*, 1886. Plate LXXXVI, fig. 18—bristle; Plate LXXXVII, fig. 17—foot.

Specific Characters.—Head with large lateral connate eyes, and traces of a dimple in the centre anteriorly. Colour reddish. Proboscis devoid of teeth and with a distinct rim. Bristles rather long, with somewhat long terminal pieces minutely bifid at the tip.

SYNONYMS.

1886. *Autolytus inermis,* De St. Joseph. Ann. Sc. Nat., 7e sér., t. i, p. 237, pl. xii, fig. 117.
1908. „ „ Elwes. Journ. M. B. A., N.S., vol. viii, p. 202.

Habitat.—Between tide-marks, Livermead, Torquay (Elwes).

Shores of Dinard, France, rarely dredged on *Rytiphlea pinastroides* (De St. Joseph).

Head of the typical form with two very large anterior eyes laterally situated, furnished with lenses and confluent with the posterior eyes, also provided with lenses. De St. Joseph states that the lateral tentacles are a little longer than the median, but this is not the case in the example procured by Major Elwes. A slight notch occurs in the median border anteriorly with traces of a fissure behind.

Body of a reddish colour, from 3—5 mm. in length, slightly tapered in front and more distinctly so posteriorly, and composed of forty-nine bristled segments, the pygidium having two cirri of moderate length. The characteristic feature, according to De St. Joseph, is the absence of teeth in the proboscis, which is remarkably long and coiled like that of *Autolytus longiferiens*. It terminates anteriorly in a smooth rim. The proventriculus is ovoid with twenty-five to thirty rows of points, and occupies segments nine to eleven. The hypoderm throughout is remarkably granular and areolar, and the tissues of the annelid are comparatively soft.

The foot (Plate LXXXVII, fig. 17) is typical, with a group of rather long bristles, having a proportionally long terminal piece and a minutely bifid tip (Plate LXXXVI, fig. 18). The first dorsal cirri are the longest, and the rest are comparatively short.

De St. Joseph found two examples with male stolons of two regions. In the first nurse-stock of twenty-seven segments the stolon had thirty-one segments; in the second the nurse-stock had thirty-one segments and the stolon thirty segments, the first three in the stolon devoid of natatory bristles. In the example from Torquay sperm-cells appear to be present posteriorly.

This species may be accepted at present, but it is probable that an exhaustive study of the British Autolytidæ may reveal relationships at present unknown.

Another *Autolytus*, viz. *A. macrophthalma*, Marenzeller, was procured by Major Elwes at Babbacombe,[1] but no example was preserved, and hence only a brief notice can at present be given.

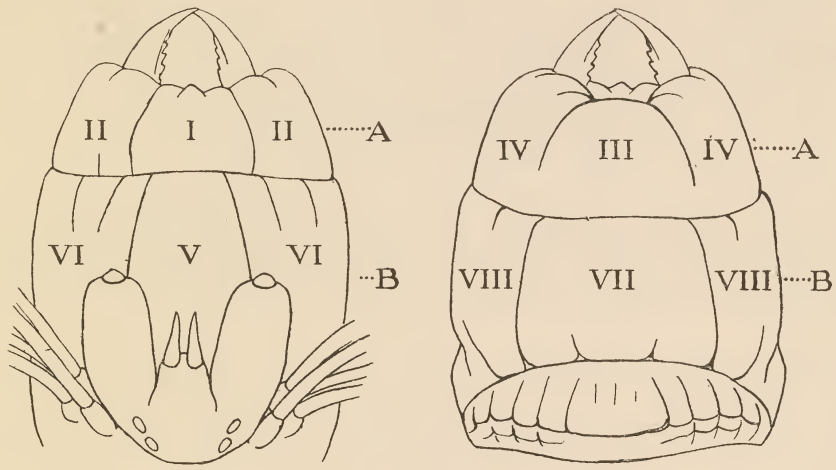
The head has four large eyes and often a few additional specks. Palpi fused dorsally. The median tentacle longer than the lateral. Tentacular cirri normal. The proboscis has a rim of twenty teeth anteriorly. Second dorsal cirrus the longest, the third considerably shorter (about one quarter the length), but longer than those which follow. Two rather thick anal cirri. The general aspect is like that of *Autolytus aurantiaca*, with forty to sixty segments. The colour is rose-orange, the tips of the tentacles and cirri being deepest. Various examples had stolons.

Marenzeller[2] found it in the Adriatic, and both Langerhans and De St. Joseph think that it closely resembles that author's *A. luxurians*[3] from the same region. It is common between tide-marks at Madeira (Langerhans), as well as in dredged material at Dinard, on the shores of France (De St. Joseph).[4]

[1] 'Journ. M. B. A.,' N.S., vol. viii, p. 201, 1908.
[2] 'Wiener Akad. Ber.,' 1875, p. 37.
[3] Ibid., 1874, p. 50, Taf. vi, fig. 1, and Taf. vii, fig. 1.
[4] 'Ann. Sc. Nat.,' 7e sér., t. i, p. 226.

Family X.—Nereidæ.

This family is characterized by the activity and muscularity of its members. The head is well formed and bears eyes and prostomial tentacles. The cephalic ganglia and nervous system generally are highly developed. The palps are massive and two-jointed. The chitinous buccal membrane is continuous with that covering the proboscis, which in extrusion is readily divided into two regions, and armed with a pair of horny jaws and a series of horny teeth (paragnathi), which after Kinberg may be arranged in eight groups, as in the accompanying outlines from *Nereis pelagica* (Figs. 58 and 58′).



Figs. 58 and 58′.—Outlines of the extruded proboscis of *Nereis pelagica*, the dorsal surface being on the left, the ventral on the right. A. Maxillary region. B. Basal region. The areas of the parognathi are in Roman numerals, viz.—I, unpaired median dorsal maxillary; II, lateral dorsal maxillary; III, unpaired median ventral maxillary; IV, lateral ventral maxillary; V, dorsal unpaired median basal; VI, dorso-lateral basal; VII, ventral unpaired basal; VIII, ventro-lateral basal.

The alimentary canal behind the proboscis is cylindrical and is furnished with a pair of glands. This is followed by a more or less simple straight intestine.

The body is elongated, rounded or somewhat flattened, segments similar, the first devoid of feet, but with two tentacular cirri on each side; the feet are usually biramous and nearly alike throughout, though the first two are simple and the caudal somewhat modified. It terminates in two cirri beneath the vent.

The body-wall (Fig. 59) in this family is surrounded by a well-developed cuticle with a considerable thickness of hypoderm beneath. The latter coat is bounded internally by the basement-membrane, within which is the circular layer of muscular fibres. The dorsal longitudinal muscles in transverse section are lappet-shaped, that is, massive externally and inferiorly, and thinning off towards the raphe in the mid-dorsal line. The ventral longitudinal muscles, on the other hand, have a characteristic dorsal and external inflection with a somewhat pennate arrangement of the fibres, the ventral portion of the muscles being spindle-shaped. The inner ventral band of muscular fibres from the bases of the spines passes to the exterior of the curvature of the ventral longitudinal muscles.

[1] *Lycoridea*, Savigny, Grube, Ehlers, etc.

At the outer border of the dorsal muscles a strong series of fibres stretches obliquely outward to interdigitate with the vertical. The oblique muscles slope downwards and almost meet in the middle line, only a central pedicle connected with the nerve-area above separating them. On each side of the median raphe dorsally is a strong fascicle

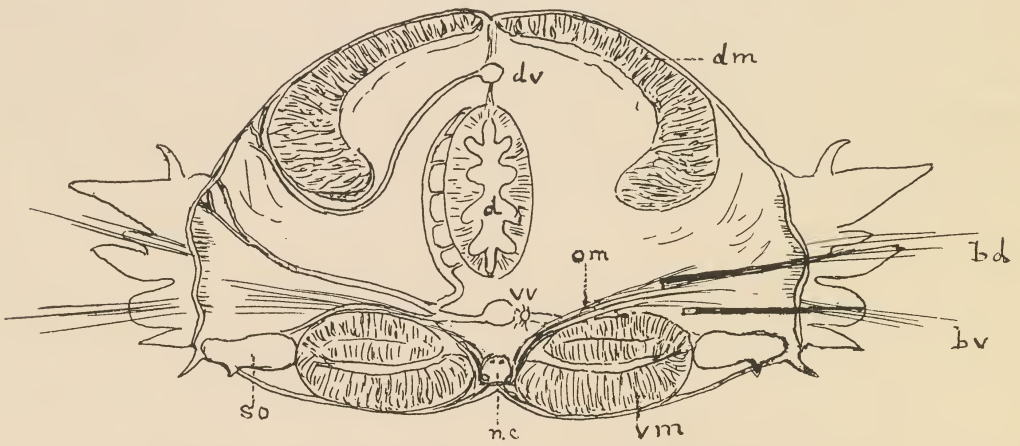


Fig. 59.—Transverse section (diagrammatic) of the body-wall of *Nereis diversicolor*. *bd., bv.* Respectively dorsal and ventral divisions of the foot. *d.* Alimentary canal. *d. m.* Dorsal longitudinal muscles. *d. v.* Dorsal blood-vessel. *n. c.* Nerve-cord. *o. m.* Oblique muscles. *s. o.* Segmental organ. *v. m.* Ventral longitudinal muscles. *v. v.* Ventral blood-vessel; the main branches of this and of the dorsal vessel are indicated. (After Goodrich and nature.)

of fibres ensheathing the blood-vessel and decussating on the wall of the alimentary canal beneath. The nerve-cords lie rather above the attachment of the oblique muscles to the basement-tissue—a central pedicle occurring beneath. As a rule two large infero-lateral neural canals (giant fibres) occur, with a median superiorly and occasionally two smaller below the latter. The circulatory fluid in some contains hæmoglobin.[1] Feet

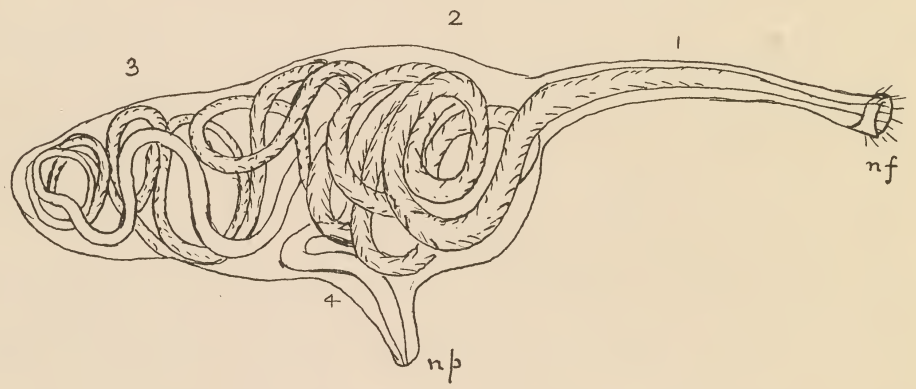


Fig. 60.—Diagrammatic sketch of the nephridium of *Nereis diversicolor*, O. F. M., with its canal, which is divided into four regions, viz. 1—4. *n. f.* Nephridial funnel. *n. p.* Nephridiopore. (Goodrich.)

somewhat complex with bifid dorsal lobe. Rarely is the dorsal lobe represented only by bristles. Bristles homo- and heterogomph.

The nephridium of *N. diversicolor* (Fig. 60) consists of a compact mass, perforated by a convoluted canal, which can be divided into several regions, and communicates with the

[1] Ray Lankester, 'Proc. Roy. Soc.,' No. 140, p. 2, 1873.

exterior by a short duct leading to a sac on the ventral surface. A long canal springs from it, and ends in front by a nephrostome provided with long ciliated processes, which opens into the next segment.

Goodrich describes the segmental organ as forming a gland-like mass of coiled and ciliated tube opening externally on the ventral surface at the base of the foot by a non-ciliated portion, and internally by a funnel—studded with cells having long cilia (Fig. 61)—into the preceding segment. He considers that the dorsal ciliated organ is a genital duct, not fully developed. The recent description by Fage[1] does not materially add to this information, but he advances the view that the separate dorsal ciliated organ of Goodrich is to be included in the segmental series, viz., as the rudimentary "*pavillon*

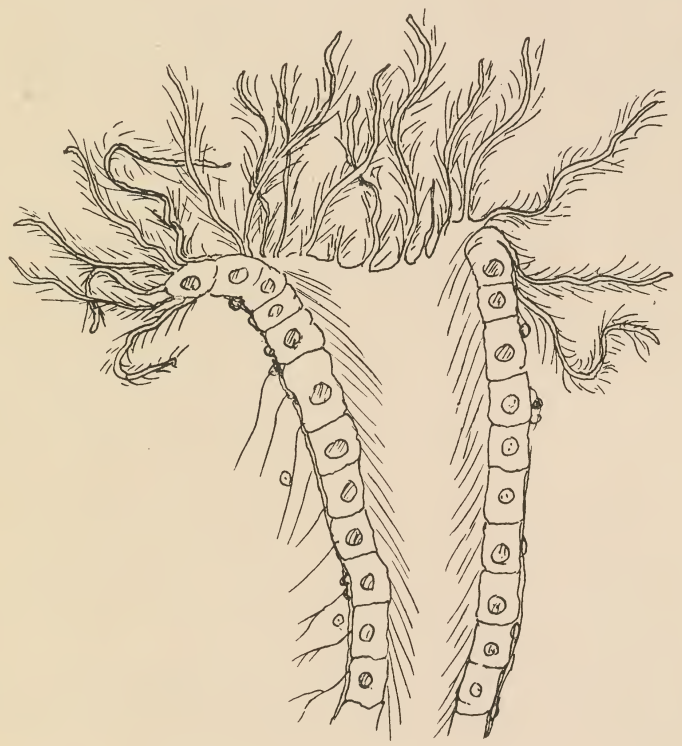


Fig. 61.—Optical section through the nephridial funnel of *Nereilepas fucata*, Sav. The long processes on the summit are external cilia, whilst the processes on the left are septa, not cilia. (After Goodrich.)

genital." He is not inclined to think it a phagocyte organ. It is noteworthy in this respect that long ago Dr. Thos. Williams credited the segmental organ in *Nereis* with both a dorsal and a ventral opening. It may be remarked that Fage insists throughout his memoir on the essential difference between the "pavillon" (which may be freely termed genital duct) and the nephridium, the former being connected with reproduction, the latter with excretion.

The sexes are separate; reproductive elements shed through the body-wall. Some undergo no change, whilst many species towards the period of sexual maturity pass through a metamorphosis into the *Heteronereis* condition. In this the eyes increase in size, the palps are reduced (Gravier), the prostomium is altered, and the body forms two regions, viz., an anterior in which the feet are unchanged, and a posterior bearing the genital

[1] 'Ann. Sc. Nat.,' 9e sér., pp. 331—347, figs. 29—35, and pl. vi, figs. 19—23.

products, and in which the feet acquire foliaceous lobes and swimming bristles. Again in some the males at maturity present a varicose or serrated condition of the dorsal cirri, whilst the females show this in a slighter degree or not at all. Dignet mentions that in May, 1901, in the Gulf of California he found male Nereids in which the body was composed of three regions, the anterior characterized by the enormous development of the dorsal cirri, which formed powerful natatory organs; a middle region with ordinary feet and cirri, and a posterior division in which the feet were metamorphosed for the epitokous condition. The eyes were very large and encroached on the ventral border, and the palps much reduced[1] (Gravier).

The comparatively great size of the ova of *Lycastis quadraticeps*, Gay, from Chili and Punta Arenas, in the Strait of Magellan, as described by H. P. Johnson,[2] is a feature of interest in this small species, for they are about half the diameter of the body, and, moreover, the species is hermaphrodite. It frequents not only the sea, but brackish and even fresh water.

In *Nereis Dumerilii* young forms may become ripe whilst still Nereids, or they may assume the Heteronereid condition during the ripening of the sexual elements; and as the larger Heteronereids frequent the bottom whilst the smaller are pelagic, there are thus three different kinds of males and females in this species (Benham).

Mr. A. Treadwell[3] is of opinion that the muscles of the anterior (unmodified) region of such as *Nereis kobiensis*, McIntosh, are greatly reduced in the *Heteronereis* condition, whilst those of the posterior region are not. He also thought that the septa had disappeared. His preparations, however, were imperfectly preserved, so that he speaks with reserve.

The family of the Nereids is, as Claparède observes, a homogeneous one, and there is little difficulty in assigning the representatives to it. Yet the foreign species are still in want of elucidation, and those from widely divergent regions may yet be brought into closer relationship than is at present possible.

It is interesting that, as a general rule, the two heterogomph bristles of the upper group in the inferior setigerous process are stouter and often more deeply tinted yellow, just as in certain Syllids.

The older authors, such as Linnæus, O. Fabricius, O. F. Müller, and others, included the Nereids under the Vermes along with parasitic worms, Gordii, Cestodes, Planarians, leeches, Ascidians, parasitic Crustaceans, Echinoderms, and Mollusca. Savigny placed them under his second family of Annelids along with *Nephthys*, *Aricia*, *Glycera*, *Ophelia*, *Hesione*, *Myriana*, *Phyllodoce*, and *Syllis*, under the Nereides, whilst the genus *Lycoris* comprehended the Nereids proper. He was followed by Lamarck, who made the genus *Spio* an appendix to the former groups. Some of the early authors again confounded the young of the Nereids with Syllids.

Audouin and Milne Edwards (1834) made them the first genus of their Nereidiens, which included all those treated in this Part. The Nereids were characterized by having the tentacles (the author's antennæ) well developed; tentacular cirri on the first segment;

[1] 'Bullet. du Mus. d'hist. nat.' (C. Gravier), No. 4, 1901.

[2] 'Biological Bulletin,' vol. xix, No. 6, May, 1908, pp. 371—385, with text-figs.

[3] Ibid., vol. ix, No. 4, Sept., 1905, p. 226.

filiform dorsal cirri; feet of two divisions, branchial lobes at the extremity of the feet; tentacles dissimilar; two jaws. In this description the lobes of the feet were termed the branchiæ, and the great vascularity of these in certain forms renders the interpretation physiologically correct, though it is not necessary to place them on the same footing as those with special branchial organs attached to the dorsal cirri.

Grube[1] (1850) grouped the Nereids under his fourth family, *Lycoridea*, Savigny s. str., two genera only being given, viz., *Nereis* and *Lycastis*, but he subdivided the first-mentioned into three divisions according to the structure of the feet. The family was placed between the Eunicea and the Nephthydea, and next year[2] he gave a synopsis of the genera and species, basing his distinctions on the head and tentacles, the structure of the feet, and the proboscis.

Dr. Johnston did much in his earlier papers to elucidate the British forms, and in the Catalogue of Worms in the British Museum (1865) he gave an excellent summary of the history and general characters of the group; but at that date the relationships of the heteronereid phase were obscure, and they were regarded as forming a distinct genus. No less than fourteen species are entered in the Catalogue, which does not include either *Micronereis* or *Leptonereis;* but of the list five are Heteronereids, though one of these refers to a species not entered elsewhere, viz. *Nereis* (*Eunereis*) *longissima*, giving in all six Nereids which stand. An examination of his collection in the British Museum[3] showed that *N. fimbriata* included various forms such as *N. diversicolor*, *N. pelagica*, and *N. Marionii*, but in all probability they had been mixed after his death. *Nereis imbecillis* was found in 1872 to be a *Nereilepas* with the paragnathi for the most part absent. It is uncertain what the *Nereis pulsatoria* of Montagu and mentioned by Dr. Johnston is. The foot as figured by Audouin and M. Edwards somewhat resembles that of *Nereilepas*, but the arrangement of the paragnathi diverges.

Dr. T. Williams[4] considered that the Nereids had a large amount of "milky perivisceral fluid," which fluctuates from one end of the body to the other. The corpuscles, he says, are superseded by true ova in autumn. The same author[5] describes the segmental organs in *Nereis margaritacea* as consisting of a tube, richly ciliated, both ends of which open externally, the ingoing dorsally and the longer outgoing ventrally at each foot, and there is no communication with the perigastric chamber. The longer limb conveys the generative elements externally. The areolated tissue of the foot receives the ova or sperms, and it is a development of the segmental organs. The female in this group is much larger, he says, than the male.

Kinberg[6] (1865) made a step in advance in the classification of the Nereids by placing the structure of the proboscis (his pharynx) on a proper footing. He termed the distal region in extrusion the maxillary ring, and the proximal the basal ring. Moreover,

[1] 'Arch. f. Naturges.,' Bd. xvi, p. 294, 1850.

[2] 'Familien der Anneliden,' p. 125, 1851.

[3] And in this connection I have to remember the kindness and courtesy of Dr. Gray, Dr. Baird, Dr. Günther, Prof. Jeffrey Bell, and others.

[4] 'Philos. Trans.,' 1852, pp. 627—628.

[5] Ibid., 1858, p. 124.

[6] 'Öfvers. k. Vet.-Akad. Förh.,' 1865, No. 2, p. 167.

he numbered the eight groups of paragnathi and utilized their presence or absence as an aid in classification. Thus, to arrange them according as they occur on the maxillary or the basilar ring, as Gravier[1] has done, they are as follows:

	Maxillary ring.	Basal ring.
Unpaired median dorsal group . . .	I.	V.
Lateral dorsal pair	II.	VI.
Unpaired median ventral group . . .	III.	VII.
Lateral ventral pair	IV.	VIII.

He made five families, or rather, as they might be termed, sub-families of the Nereids, according to the presence of these papillæ and their nature, or their absence, using the structure of the feet, the bristles, and other features in separating the subordinate groups.

De Quatrefages (1865) classified the Nereides according to the condition of the body, viz., those having one region or two, the uniramous or biramous nature of the feet, and the foliaceous condition of the latter. Since he included as separate genera the Heteronereids, the classification is now obsolete. In his characters of the genus *Nereis* he terms the palpi the external lateral antennæ, and the tentacular cirri tentacles. The lobes of the feet are considered as branchiæ.

Malmgren (1867) arranged the genera according to the uniform or dissimilar feet along the sides of the body, the characters of the bristles, and the structure of the paragnathi. He made two great groups, according to the foliaceous or non-foliaceous condition of the superior lamella of the dorsal lobe of the foot. Then again he subdivided them into those having the feet uniformly constructed throughout, and those in which the feet in the posterior region were transformed. His other characters rest on the form of the dorsal lobe and the condition of the paragnathi. As the epitokous forms are included in this arrangement, considerable changes are necessary.

This author[2] has the credit of having subsequently discovered the relationships between the Heteronereis-condition and the ordinary one in *Nereis pelagica*, in which the male is *Heteronereis grandifolia*, and between *Heteronereis fucicola* and *Nereilepas variabilis*, Œrst., which he deemed equivalent to *Nereis Dumerilii*. He also showed that examples of *Nereis Dumerilii* were either male or female, and that others with ova assumed the *Iphinereis* form. He was followed at no long interval by Ehlers, Claparède, and others on this important question.

Cosmorici (1880) described the segmental organs in *N. bilineata* as in pairs on the posterior faces of the dissepiments in the middle region of the body.[3]

Following Malmgren, Ehlers[4] pointed out the relationship of *Heteronereis* to *Nereis* and *Nereilepas*, taking especially *Nereis Dumerilii* with its conspicuous characters as an example, and alluding to the analogous condition in the *Syllids* with their swimming bristles.

The same author (1868) characterizes the family *Lycoridea*, Savigny, Grube, as having an elongated and distinctly segmented body. Head clearly differentiated with

[1] 'Nouv. Arch. Mus. Paris,' 4e sér., t. iii, p. 151.

[2] 'Zeitschr. f. wiss. Zool.,' Bd. xix, p. 466; and in 'Arch. f. Naturges.,' Bd. xxxv, p. 58, 1869.

[3] 'Thesis,' p. 113, pl. xxvi, fig. 14.

[4] 'Nachricht. d. k. Gesellsch. zu Göttingen,' pp. 209—217, 1867.

two tentacles, two palpi, and four eyes. First segment devoid of a foot, with two pairs of tentacular cirri on each side, and two cirri below the anus. Proboscis with two regions in extrusion, furnished with paragnathi, rarely naked, and with two jaws, which in retraction fall behind the two regions.

He divides the family Lycoridea as follows:

1. Feet single—*Lycastis*,[1] Aud. & Edw.
2. Feet bifid:
   (*a*) With simple dorsal cirri.
      1. With dorsal and ventral lamellæ—*Nereis*, Cuvier.
      2. Devoid of dorsal lamellæ—*Ceratocephale*, Malmgren.
      3. Devoid of central lamellæ—*Tylorhynchus*, Grube.
   (*b*) With plumose dorsal cirri—*Dendronereis*, Peters.

Ehlers did good service in showing that many of the generic terms used by Kinberg, Malmgren, and others, were due either to sexual variations or were otherwise unnecessary.

He grouped the species as follows:

A. The dorsal lobe of all the feet simple, that is, without an enlarged lamella.

I. The feet on all the segments uniform or only little altered.

1. Paragnathi complete, including the British *Nereis cultrifera*.
2. Paragnathi incomplete, comprising *Nereis pelagica*, *N. longissima*.

II. The feet unequal.

1. Four or five of the anterior segments have the lobes of the feet little developed, the following feet with prominent lobes.
   (*a*) Paragnathi conical.
      Nereis irrorata, *N. Dumerilii*.
2. The posterior feet elongated, with long lobes and processes.
3. The posterior feet elongated, the dorsal border, from which springs the cirri, very convex.
      Nereis fucata.
4. The dorsal lobe of the posterior feet broadly triangular.
      Nereis diversicolor.

B. The upper lobe with the cirrus bearing a large lamella.

I. The upper lobe in the first feet not leaf-like.
      Nereis virens, Sars.

II. The upper lobe only in the middle, and posterior feet foliaceous.

1. The dorsal cirrus terminal.
   (*a*) Paragnathi complete, conical.
      Nereis Marionii, Aud. & Edw.
2. The dorsal cirrus prominent in the posterior feet (no British form).

Claparède, in 1868, placed the Nereidæ under the sub-genera *Leontis*, Malmgren, *Lipephile*, Malmgren, *Ceratonereis*, Kinberg, *Nereilepas*, Blainville, Johnston, Malmgren, making a special genus of *Heteronereis*. The same author, in an elaborate investiga-

[1] *Vide* Grube's view, p. 256.

tion into the Heteronereid condition of the Neapolitan Nereids, in 1870, groups the bristles of the Nereids into two divisions:

(1) Heterogomph bristles in which the distal end of the shaft is prolonged in a point, so that an oblique articulation takes place.

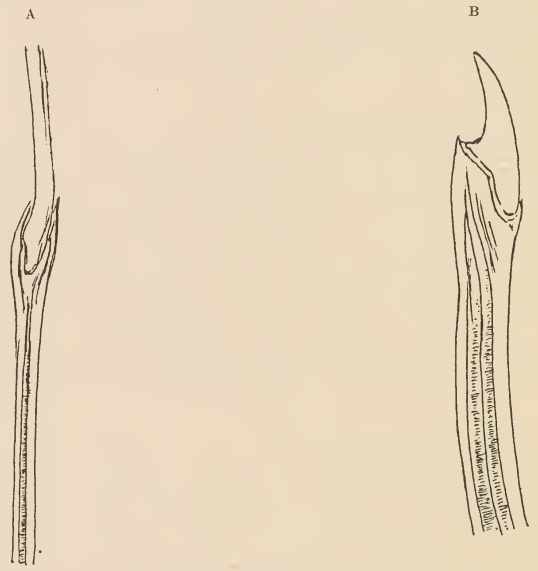


Fig. 62 A and B.—Homo- and heterogomph bristles of *Nereis pelagica*.

(2) Homogomph, in which the distal end of the shaft forms a kind of sheath for the terminal piece; but the fact that in the ventral division of such forms as *Nereis pelagica*, L., and *Nereis cultrifera*, Grube, a gradual transition from the former to the latter occurs, shows that the distinction is artificial. He places some weight on the distribution of the various bristles (four kinds) in the foot. He further describes two canals in the maxillæ of the Nereids in communication with the base, and opening between the first two (distal) teeth, that is, the tip and the first tooth. In the heteronereid of *Nereis Dumerilii* he found the cavity of each maxilla occupied by a peculiar protoplasmic tissue with nuclei, but whether the reticulated tissue secreted poison he could not say. On the whole the beautiful drawings and the numerous observations by Claparède on the Nereids in the two works just noticed make an epoch in their history.

Grube,[1] in 1873, entered into an elaborate review of the characters upon which he based the classification of the Nereidæ, these being chiefly the armature of the proboscis and the structure of the feet. His main divisions are as follows:

A. Foot with two bristle-bundles, but not fissured accordingly.

Lycastis, Sav. The foot is not split into tongue-like processes. It has small lobes with the bristle-bundles. Proboscis without paragnathi.

B. Foot divided into a dorsal and a ventral division.

B[1]. The dorsal cirrus simple.

Nereis, L. s. str., Aud. & Edw. The border of the foot split into three tongues, the upper and middle pertaining to the dorsal, the ventral to the ventral division.

Proboscis with paragnathi, seldom with soft papillæ.

[1] 'Schles. Gesell. f. v. Cultur,' Dec. 19th, 1873, p. 13

Ceratocephale, Malmgren. Without the upper tongue or lobe, but with lip-lobes and middle tongue, the inferior division as in *Nereis*.

Tylorhynchus, Gr. Only the upper and middle tongues of the feet present. The proboscis beset with hard papillæ.

B[3]. The dorsal cirrus in certain segments furnished with branches (an arbuscle). Ex. *Dendronereis*.

In his 'Philippine' Annelids (1878) he groups the Nereids under the family Lycoridea —with *Nereis* and *Dendronereis* as sub-families. He relies on the condition of the proboscis as the basis of his subdivisions, *e.g.*, *Leptonereis*, *Ceratonereis*, *Platynereis*, *Lycoris*, and *Perinereis*. He had previously reviewed the group on similar lines, his main divisions agreeing with those of Ehlers; but he clearly indicates that *Lycastis* has two bristle-bundles in the foot, though it appears to be simple.

Levinsen (1883) made the Nereids (Lycoridæ) the first family of his *Syllidiformia vera*, whereas Benham places them as the sixth family of his Nereidiformia. There is less objection to the associations of the former than to those of the latter. He follows the previous authors, Kinberg, Grube, Malmgren, and Ehlers, in his generic and specific characters.

R. Horst[1] (1889), in dealing with the Nereids belonging to the sub-genus *Perinereis*, follows Grube in showing that the lateral dorsal paragnathi of the basal ring of the proboscis (Group VI) are all, or some of them, transversely ridge-shaped, the remaining paragnathi being conical or pin-shaped (pectiniformes, Kinberg) or compound. The feet are all of the same structure, or those of the posterior region enlarged. The group comes under Kinberg's *Aretidea*, but not his genus *Perinereis*. Horst includes *Nereis cultrifera*, Grube, under this series.

De St. Joseph,[2] in 1898, adopted the classification of Kinberg, founded mainly on the condition of the paragnathi, though the primary divisions are based on the presence or absence of dendritic branchiæ. In addition he uses the condition of the buccal segment and the uni- or biramous nature of the feet. It is a question how much importance can be attached to this method of classifying, though it may be useful. The British species would chiefly fall under the fifth group of the second great division, viz., *Nereis*, characterized by separate, horny, conical paragnathi, *Alitta* and *Hediste*, p.p., having all the groups complete, whilst Group V or Groups V and VI are wanting in *Nereilepas*, *Hediste*, p.p., and *Praxithea*. In *Eunereis*, again, all the groups except VI are absent. In the sixth division are those in which there are separate, horny, conical, and transverse paragnathi, all the groups being complete in *Lipephile*, Mgrn., *Hedyle*, Mgrn., *Hediste*, Mgrn. p.p., *Stratonice*, Mgrn., and *Nereilepas*, Blv. *sensu* Johnst. In the eighth section the horny paragnathi are very small, numerous, and ranged in rows, *e.g.* the genus *Platynereis* including *Leontis* of Malmgren. As genera occur under more than one head, confusion is apt to arise by too strict adherence to such a classification.

Gravier (1901), in his 'Annelids of the Red Sea,' followed in the lines of Grube and Kinberg, that is, made the arrangement of the paragnathi when present, and, in their absence, the structure of the feet, the foundations of his genera, except in the case of

[1] 'Notes from the Leyden Museum,' vol. xi, pls. vii and viii, 1889.

[2] 'Ann. Sc. Nat.,' 8e sér., v, p. 283 *et seq.*

Dendronereis from Mozambique and the Philippines, in which the ramifications of the dorsal cirrus are alone diagnostic. In his specific characters he makes use of the number of the different bristles in each division of the foot, a method that has not been followed here. Of the genus *Nereis* he makes four sub-genera, viz., (1) those in which all the eight groups of paragnathi are present (*Neanthes*, Kinberg); (2) those in which one or more groups are absent (*Nereis* s. st. Kinberg), whilst the third and fourth sub-genera have the paragnathi only on one ring,—*Ceratonereis*, Kinberg, having them on the maxillary, and *Eunereis*, Malmgren, having them only on the basal ring.

For the British species of *Nereis* it is unnecessary to make a special classification. The main lines of previous efforts have been indicated in the foregoing summary, and that of Ehlers, for instance (p. 255), will suffice for reference. The structure of the body-wall throughout the series presents no basis for differentiation, so that characters derived from the armature of the proboscis, the structure of the feet, and other points, are alone available. Moreover it is doubtful how far the presence of a continuous bar of chitin in Group VI should be relied on as a satisfactory distinctive character, the two British forms which fall under this head being *Nereis* (*Perinereis*) *Marionii* and *Nereis cultrifera*. Little is gained by its adoption, since otherwise there are no bonds of note. Then, again, the British forms with a complete series of paragnathi from I to VIII are *N. cultrifera* and *N. virens*, yet in other respects there is no special connection. Neither is the absence or scanty presence of paragnathi, as in *Nereis longissima*, followed by other special characters, though the condition is interesting (*e.g.* in the foreign *Lycastis*). All the British forms have distinctly biramous feet, that is, a dorsal and a ventral division, no example of *Lycastis* having yet been procured on our shores, though a persevering search on the southern coasts might be successful.

In his researches on the eyes of Annelids, Andrews[1] (1892) regards the whole eye as epidermal, and he gives figures of the minute structure in *Nereis*, showing that behind the lens is a central axis with its sheath followed by blue pigment, then yellow pigment in the central nerve-axis with its nucleus, and nerve-processes posteriorly.

Various allusions are made to the development of Nereids, and amongst others the youngest larvæ mentioned by Milne Edwards[2] (1845) had three complete segments and a fourth developing, two anterior cirri, two tentacular cirri, and two anal cirri.

Busch[3] (1851) describes a free-swimming larva of *Nereis* with six bristled segments, two sub-tentacles, two anal cirri, and four eye-specks.

Wilson[4] (1892) describes a monotrochous larva of *Nereis limbata*, which exhibited marked heliotropism. In the following stage on the twelfth day it is still pelagic, but is less active.

Goette[5] gives an account of a small prototroch of *Nereis*, and Salensky[6] alludes to the pelagic stages of *Nereis Dumerilii* with three pairs of feet and a pair of eye-specks. He also describes the ninth day larva of *Nereis cultrifera* as having three pairs of feet with bristles, two frontal cirri, two tentacular cirri, and two anal cirri.

[1] 'Journ. Morphol.,' 1892.
[2] 'Recherches,' p. 167, Taf. x and xi.
[3] 'Beobacht.,' p. 69, Taf. ix, fig. 11.
[4] 'Cell Lin.,' 1892, p. 120, figs. 82 and 91.
[5] 'Unters.,' 1882, p. 84, Taf. vi, fig. 19.
[6] 'Etud.' ii, 1882, Taf. xxiv, fig. 10 N.

Häcker (1896) describes and figures the metatrochophore stage of *Nereis* with three pairs of feet and three pairs of eye-specks, and later[1] (1898) a Nectochæte stage with four bristled segments and two eyes. In *Nereis limbata* the prototroch appears in ten hours, in another twenty hours it swims as a monotroch, and in two and a half days it assumes what he calls a three-segmented Nauplius-stage. It ceases to be pelagic about the twelfth stage. This author groups the Nereids with the Nephthydidæ, Phyllodocidæ, Eunicidæ, and Aphroditidæ in having a secondary nectochæte stage.

The Nereids are generally found in tubes between tide-marks or near low-water mark—sometimes under the nest of *Amphithoë*, at others in an independent dwelling in fissures of rocks, under tangle-roots, in decayed stalks of the same sea-weed, or in sponges. They also frequent the laminarian and coralline regions, and range to considerable depths, as in certain examples from the 'Challenger,' and those frequenting holes in telegraph cables. Some occur in masses of peat, either having made the tubes or having driven out those which made them, and others occupy tubes composed of fragments of shells, corallines, algæ, sand, gravel, and secretion; or the tubes are more or less transparent. Many are found in the stomachs of cod, haddock, and other fishes at St. Andrews. Mr. Cyril Crossland communicates a note on a brilliant orange-red Nereid, common at Dongonab in the Red Sea, in a thin collapsible tube attached throughout its length. If the annelid is removed and placed in a vessel of sea-water, the tube is rapidly re-formed. They are muscular annelids that wriggle most dexterously out of the forceps, but unlike the common eel do not always make good use of their opportunities on the ground, though they swim with vigour and agility. They soon die when kept with other collections in a bottle, and rapidly putrefy. Their skins are extremely sensitive to vapour of alcohol.

A few Nereids are commensalistic, like *Nereilepas fucata* with the hermit crab in the shell of *Buccinum*, and the orange species procured by Prof. Giard[2] in the folds of *Balanoglossus*[3] on the rich sandy beaches of l'Iles Glénans. The unarmed proboscis and the reduced condition of the dorsal lobe of the foot with its simple bristles would indicate its relationship with *Lycastis*, species of which have been found at Rochelle and elsewhere on the shores of France.

Some devour other annelids, Crustacea, and sponges, the spicules of which occur in their intestines; whilst others, like *Nereis Dumerilii* and *N. cultrifera*, are partial to Algæ.

All the British forms are marine, though *N. pelagica* moves far up the inlets in North Uist, and *N. diversicolor* also is found in brackish regions; Cuvier, indeed, suspected that true Nereides may be found in the lakes of North America, though the reasons for this view are not stated. A considerable number of foreign species, however, occur in fresh water and many in brackish water.[4] Such forms chiefly pertain to the genus

[1] 'Plankton Exped. Polychæt.,' p. 9, Taf. 1, figs. 3 and 3A.

[2] Since this was written the distinguished French naturalist has died. He was one of the foremost marine zoologists of his day in France, and equally esteemed in other countries.

[3] 'Compt. Rend.,' Aug. 21, 1882, p. 389; 'Ann. Nat. Hist.,' 5th ser., vol. x, p. 230.

[4] Interesting accounts are given by C. Gravier, 'Bullet. Soc. Philomathique de Paris,' 1901, and 1905, pp. 1—12, sep. copy. See also H. P. Johnson, 'Mark. Anniv. Vol.,' art. x, pp. 208—223, pls. xvi and xvii, 1903.

Lycastis, in which the dorsal division of the foot is rudimentary, being represented as a rule by a spine and a few bristles. A recent contribution by Dr. R. Horst[1] on one of Johnson's species (*Lycastis hawaiensis*) shows that the dorsal cirrus becomes greatly developed. This form seemed to have been conveyed to the fresh-water pond of the Botanical Gardens at Buitenzorg in transplanting mangrove trees.

No example of *Ceratocephale* (a form with soft papillæ in the proboscis) has yet been found in British waters, yet it occurs on the opposite shores of the Atlantic (Canada), in Sweden, and in Japan. The Japanese species, *Ceratocephale osawai*, Izuka,[2] is the "Palolo" of their seas, occurring in swarms in October and November close to the new and the full moon, and thus in four different periods each lasting a few days. It, like the swarming *Nereis Dumerilii* of Britain, is much used as bait, and is captured at night with nets, each boat having a lantern to attract the worms. It differs from the Atlantic and Pacific "Palolos" not only in family, but in the fact that its posterior end is shed as a useless product, the ova and sperms being discharged from the open posterior end of the anterior region, which swims freely. Dr. H. C. Sorby[3] has found in the summer months Heteronereids swimming very actively off the estuary of the Thames and elsewhere, and then suddenly disappearing.

SECTION I.

NEREIDÆ WITHOUT PARAGNATHI IN THE PROBOSCIS, AND WITH BIRAMOUS FEET.

1. *Micronereis variegata*, Claparède.[4] Head without tentacles or palpi; peristomial segment with feet and bristles. Bristles all homogomph with long slender tips. Length 4—6 mm.

2. *Leptonereis vaillanti*, De St. Joseph. Head rounded, buccal segment passing below, so that the tentacular cirri appear at its sides; conspicuous glands in feet. Bristles of more than one kind. Length 30 mm.

Genus LVIII.—Micronereis, *Claparède*, 1863.

Buccal segment bears feet and bristles. Proboscis muscular, only with maxillæ.

Foot deeply cleft, with a dorsal and a ventral cirrus. Bristles uniform throughout; homogomph.

This genus, therefore, would naturally fall into the group devoid of paragnathi, and is specially distinguished by having bristled feet on the buccal segment.

[1] 'Bullet. Dep. Agric. aux Indes Neerlandaises,' No. xxv, p. 1 (sep. copy).

[2] 'Journ. Coll. Sci. Imper. Univ. Tokyo,' vol. xvii, art. ii, pp. 1—37, 2 pls.

[3] 'Journ. Linn. Soc.,' vol. xxix, p. 434, 1906.

[4] See a useful key to the British species by Major Elwes, 'Journ. M. B. A.,' n.s., vol. viii, p. 357, 1909.

1. Micronereis variegata, *Claparède.* Plate LXXXVI, fig. 8—bristle.

Specific Characters.—Head rounded in front, with traces of palpi, and four large eyes, the anterior pair wider apart and with lenses. Tentacular cirri four, enlarged at the base, which is coloured greenish or yellow.

Body 4 mm. long, very little tapered in front, but diminished from the third segment to the tail, which has two caudal cirri of the same tint as the tentacular cirri (Claparède). Bristled segments nineteen to twenty. Proboscis muscular; two horny maxillæ with five teeth.

With the exception of the first two, the feet are deeply biramous, the setigerous lobes dilated distally and furnished with a subulate and subterminal dorsal and ventral cirrus. Each lobe has a group of translucent homogomph bristles, with long, finely tapered terminal pieces, the dorsal being somewhat longer than the ventral.

Synonyms.

1863. *Micronereis variegata,* Claparède. Beobacht. ü. Anat., p. 57, Taf. xi, f. 5—7.
1864. „ „ idem. Glanures Zoot., p. 122, pl. viii, f. 4.
1865. „ „ De Quatrefages. Annel., i, p. 578.
1893. „ „ Racovitza. Compt. Rend., 12 June, 1893.
1894. „ „ idem. Ibid., 15 Jan., 1894.
1900. „ „ Fauvel. Mém. Soc. Nation. etc., Cherbourg, T. xxxi, p. 315.
1909. „ „ Elwes. Journ. M. B. A., n.s., vol. viii, p. 350.

Habitat.—Under a stone between tide-marks, St. Peter Port, Guernsey, July, 1868; amongst littoral red algæ and *Lithothamnion* between Oddicombe and Babbicombe (Elwes).

St. Vaast-la-Hougue, Normandy (Claparède).

Head (Fig. 63, p. 262) rounded in front, and devoid of tentacles or palpi, though in a preparation kindly forwarded by Major Elwes a bluntly conical process projected ventrally on each side, but such may have been connected with the proboscis. Four large black eyes arranged in a trapezoid occur on the head, the anterior pair with lenses and wider apart. The posterior pair show minute, glistening points as if from crystalline cones. Tentacular cirri, four on each side, enlarged at the base and banded with green or yellow and tapered distally, one of each pair being dorsal, the other ventral.

Body about 4 mm. long, little narrowed in front, and tapering from the third foot gradually to the tail, which ends in two long, tapering cirri. Bristled segments nineteen or twenty. The general colour is brown, as Claparède notes.

The proboscis is a proportionally large muscular organ with two powerful maxillæ of a golden colour, short and broad in form and with five teeth on the edge in front (Fig. 63), the largest tooth being anterior. In his first figure of the maxillæ Claparède indicated only three teeth on the edge, but his next representation shows six on one side and seven on the other.

The first foot is small and uniramous, and is borne apparently by the buccal segment. It has a somewhat clavate setigerous region, that is, the process enlarges

toward the distal end, a pale spine, and a tuft of translucent bristles like those following.

The second foot has a much larger setigerous region also enlarged distally and curved, the convexity being in front in the preparation. A spine and a group of bristles are also present. Claparède found a cirrus in both this and the first foot. The preparations had lost them.

The third bristled segment bears a bifid foot, and this condition continues to the posterior region. The typical foot (Fig. 63) consists of two widely separated divisions, the split proceeding almost to the base, the spine in each division arising close to its neighbour, and then gently diverging to the tip of its respective lobe. The superior division in the specimen from the Channel Islands is somewhat clavate—that is, distinctly enlarges till a well-marked knob for the cirrus on the upper surface is reached. The tip then narrows to an acute angle (in spirit) occupied by the spine, which slightly projects.

Fig. 63.—Head and anterior region of *Micronereis variegata*, Claparède, somewhat compressed. (After Claparède.)

The inferior division of the foot has a similar shape reversed, and the ventral cirrus is about the same size. The dorsal surface of the upper division is ciliated and may assist in respiration (Claparède).

The bristles (Plate LXXXVI, fig. 8) are slender, translucent structures with a slight curvature of the shaft, and an enlarged tip which is homogomph, the long, slender, tapering terminal piece being sunk in the pit of the bifid region. In the example from Guernsey the upper bristles (four to five) lay beneath the spine, whereas the inferior bristles appear under pressure on both sides of the spine, and they are somewhat shorter than the upper. As Major Elwes remarks, the tips of the bristles represented by Claparède differ in being shorter, wider, and with a more distinct tendency to curvature.

Reproduction.—Claparède's first example was a female, and he found eggs 0·08 mm. in the cœlome in summer (July). As mentioned below, Racovitza more recently has given an excellent account of the reproduction of this form.

This is one of the numerous discoveries of the accomplished and indefatigable Claparède on the southern shores of Europe. He found a somewhat larger form (6 mm.) at Port Vendres,[1] which had a third small, horny point between the tips of the

[1] 'Glanures Zoot.,' p. 122, pl. viii, fig. 4, 1864.

maxillæ, but gave it no distinctive name. It probably is an older example of the same species.

De Quatrefages (1865) thought that in regard to the fusion of the head and buccal segment and in the structure of the feet it diverged from the Nereids; indeed, he would have considered it a larval form if Claparède had not found ripe ova. Ehlers, on the other hand, is doubtful concerning its position, and would even connect it with the Aphroditidæ.

De St. Joseph[1] places *Micronereis* under the group devoid of paragnathi and having a biramous foot, by which it is distinguished from *Lycastis;* whilst it is separated from *Leptonereis*, which he places next it, by having bristled feet on its buccal segment. Gravier[2] follows a similar arrangement.

Racovitza (1893) gave an interesting account of the sexual distinctions of this form, only the females of which, with twenty-one pairs of feet, had been seen by Claparède and De St. Joseph. He found the male very minute, only 2 mm. long, or half the length of the female, and with fewer feet—sixteen to seventeen pairs. Moreover, it has copulatory ventral hooks on the third pair of feet which do not exist in the other sex. The maxillæ likewise differ, for they have in addition to the smaller teeth three larger posterior points. On the other hand the female has only five teeth. The reddish eggs, which are about sixty in number, are deposited in glairy mucus, and the larvæ escape from this when they have five pairs of feet. The mature female undergoes considerable changes. Thus the cirri enlarge, become ovato-lanceolate, and the anal cirri are elongated. The posterior region of the body seems to be paralysed, and the animal drags it through the glairy mucus by aid of the anterior region. This author a little later[3] gave a description of the amœbocytes, the ovogenesis, and the deposition of the eggs in the same form.

When observed in life in Guernsey it was at first sight, from its activity, associated with the Hesionidæ, but a more careful examination, independently of any reference to literature, showed that it most nearly approached the Nereids, a conclusion which substantiates the original view of Claparède and of others subsequently.

Genus LIX.—Leptonereis, *Kinberg*, 1865.

Head rounded in front, eyes large, buccal segment and tentacular cirri shifted forward; anterior dorsal cirri peculiarly modified; tail with two bluntly conical lamellæ and two slender subulate cirri above them.

Foot without spine or bristles dorsally in the first two segments, the rest boldly split into two divisions.

Leptonereis was constituted by Kinberg[4] one of the genera of his family Niconidea in which the paragnathi are absent. He characterizes the new genus as devoid of paragnathi

[1] 'Ann. Sci. Nat.,' 8e sér., t. v, p. 285, 1898.
[2] 'Nouv. Arch. Mus.,' 4e sér., t. iii, p. 155, 1901.
[3] 'Compt. Rend. Acad. Sci.,' January, 1894.
[4] 'Öfvers. k. Vet.-Akad. Förh.,' 1865, p. 179.

(or soft papillæ?); form of foot altering by degrees, the superior branchiæ (lamellæ) becoming large posteriorly—elongate and compressed; the dorsal cirri terminal; jointed bristles both long and short. His single example *L. lævis* came from a gulf beyond Guayaquil.

Claparède[1] thought that the changes in the feet of the three genera, *Nicon*, *Leptonereis*, and *Nicomedes* proposed by Kinberg under his family Niconidea, were of secondary importance, and he united them all under *Leptonereis*.

Grube[2] likewise minimised Kinberg's group Niconidea, and placed his example under *Nereis* (*Leptonereis*).

1. Leptonereis Vaillanti, *De St. Joseph*, 1888. Plate LXXXVI, figs. 9 and 9 *a*—bristles.

Specific Characters.—Head large, rounded in front, typical in regard to appendages; four large eyes with lenses; buccal segment twice the breadth of the others; four pairs of tentacular cirri, short, and appearing from above to be cephalic in position. Body 15—20 mm. long, segments forty-eight to sixty, tapering posteriorly, and ending in two bluntly conical processes closely applied to each other, and two slender subulate cirri above them. Anus in front and dorsal to these processes. Colour pale rose with darker touches.

Proboscis has only a pair of well-developed maxillæ with twelve to fourteen teeth. First two feet have dorsal cirri, a pointed lamella beneath devoid of spine and bristles, whereas all the other feet are complete, viz., dorsal cirrus, upper lamella, rounded setigerous lobe with a black spine and homogomph bristles, whilst the inferior division has a double setigerous region of a triangular shape, with two groups of bristles and a powerful black spine. Upper group of bristles homogomph with some falcate heterogomph, lower group with homogomph and a large number of heterogomph. Beneath is an inferior lamella and a small ventral cirrus.

Synonyms.

1888. *Leptonereis Vaillanti,* De St. Joseph. Ann. Sci. Nat., 7e sér., t. v, p. 246, pl. x, f. 113—123 pl. xi, f. 124.
1909. „ „ Elwes. Journ. M. B. A., n.s., vol. viii, p. 351.

Habitat.—A male heteronereid was found between tide-marks in February at Oddicombe, Devon, by Major Elwes.

Shores of Dinard, France (De St. Joseph).

Head (Fig. 64) in the ordinary form (female nereid), according to De St. Joseph, is large, rounded in front, with four large violet eyes with lenses, the anterior pair elliptical, the posterior rounded. The buccal segment is twice the breadth of the others, and the four pairs of tentacular cirri are short and appear from above to be almost cephalic in position.

Body is from 15 to 30 mm. long, and has from forty-eight to sixty segments.

[1] 'Annél. Chætop. Nap.,' Suppl., p. 90, 1870.
[2] 'Annulat. Semper.,' p. 61, 1878.

It tapers posteriorly, and ends in two bluntly conical processes closely applied to each other, and two slender subulate cirri above them. The anus is in front and dorsal to these processes. Mounted as a transparent object, rows of glands cross the dorsum of each segment between the feet. Colour, pale rose with darker touches.

The proboscis (Fig. 64) has well-developed maxillæ with about twelve or fourteen teeth, and two canals pass from the hollow base forward to the tip. These De St. Joseph considers to be poison-canals. The roseate stomach has two lateral pouches which, after Eisig, De St. Joseph considers to be air-chambers.

The first two feet have only the dorsal cirrus which is of a slightly bent fusiform shape, a pointed lamella beneath in the superior division which is devoid of spine and bristles, whereas all the other feet have this division complete, viz., dorsal cirrus, upper lamella, rounded setigerous lobe with a black spine, and homogomph bristles (Plate LXXXVI, fig. 9) and a second lamella.

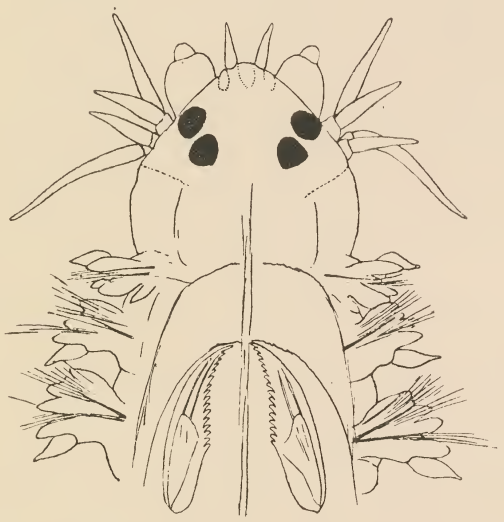


Fig. 64.—Head and anterior region of *Leptonereis Vaillanti*, from a preparation forwarded by Major Elwes.

The inferior division has a double setigerous region of a triangular shape, the one covering the other, with two groups of bristles and a powerful black spine. In the upper group are homogomph with some falcate heterogomph; the lower group is composed of homogomph and a large number of heterogomph falcate bristles (Plate LXXXVI, fig. 9 *a*). De St. Joseph states that the bristles are identical in structure with those figured by Claparède[1] in *Leptonereis glauca*. Beneath the foregoing is an inferior lamella and a small ventral cirrus. The feet vary in the several regions; thus the first four are small and have a large dorsal cirrus which projects beyond the upper lamella, whereas at the fifth the cirrus is of the same length. Then the lamellæ become prominent, and continue so to the posterior end, where, for ten segments, the cirrus again extends beyond it. After the tenth or twelfth three greyish glands occur on the dorsum of each foot, and they are conspicuous in the posterior segments (De St. Joseph).

De St. Joseph found both male and female heteronereids between June and October, yet he did not secure a male in the nereid condition. The female heteronereid resembles

[1] 'Annél. Nap.,' Suppl., pl. vii, fig. 3 B.

the nereid female except that the large eyes are almost coalescent, the colour of the body is dark orange, and from the sixteenth to the fourth in front of the tail swimming bristles are present. The reddish-brown male heteronereid he procured in August, and it measured about 20 mm. and had fifty-seven segments. The head has enormous eyes, whilst the body has three regions. The first region is composed of fifteen segments having bristles resembling those of the nereid form. The first four feet have the peculiar hook-like dorsal cirrus, the first two, as in the nereid, having neither spine nor bristles dorsally. Segments five to eight have the dorsal cirrus spatulate, whilst from nine to sixteen it is short and subulate. The second region consists of thirty segments with swimming bristles on the feet, and the heteronereid lobes are greatly developed, the largest being the foliaceous lobe of the inferior division. The third region comprises eleven segments and is translucent, or, if the sperms are developed, white. The feet resemble those between the ninth and sixteenth, only their lobes are less developed. Moreover, the inferior division has curious brown spines with a crotchet-like tip. The tail resembles that of the nereid form, and the tissues are transparent (De St. Joseph).

Unfortunately the single preparation of the heteronereid is incomplete, so that only an imperfect account of this form is at present possible. The foregoing remarks, however, will aid in the discrimination of the form, the life-history of which is still in need of investigation.

SECTION II.

NEREIDS WITH SEPARATE HORNY PARAGNATHI.

The British forms[1] in this group may for convenience be arranged according to the condition of the paragnathi thus :—

1. All the eight groups of paragnathi present.

   Nereis (*Alitta*) *virens*, Sars. With a leaf-like dorsal lamella. Large bluish-green worm, varying in size and occasionally reaching three feet in length.

2. Group V or V and VI absent.

   Nereis pelagica, L. Marked distinction between proximal and distal rows on ventral surface of basal segment. Dorsal cirri longer than feet. Length 4—8 ins.

   Nereis (*Hediste*) *diversicolor*, O. F. Müller. Distinguished from *N. pelagica* by the much smaller paragnathi and the broader head ; dorsal cirri not longer than feet.

   Nereis (*Praxithea*) *Schmardæi*, De Quatrefages. Conspicuous glands in feet; feet bluntly lobate in front, but upper lobe much elongated posteriorly. Length 4—6 ins.

   Nereis (*Leontis*) *Dumerilii*, Aud. & Edw. Paragnathi very minute, closely arranged in pectinate rows. Two glands on each foot posteriorly. Very long tentacular cirri. Length 2—3 ins.

   Nereis (*Nereilepas*) *fucata*, Savigny. Dorsal lobe of foot large with the cirrus

[1] *Vide* a useful key to the British species by Major Elwes, 'Journ. M. B. A.,' vol. viii, p. 357 1909.

arising from the dorsal edge. Two white longitudinal dorsal bands. Commensal of hermit crab. Length 4—9 ins.

3. Transversely elongated as well as conical paragnathi.

Nereis cultrifera, Grube. Paragnathi conspicuous, VI transversely elongated, and the basal ventral in two regular rows. 6—12 inches in length.

Nereis (*Stratonice*) *Marionii*, Aud. & Edw. Paragnathi small, VI transversely elongated at the base, pointed distally. Considerable dorsal elevation commences at thirtieth foot and increases posteriorly to a long lobe with the cirrus at its extremity. Length 3—4 ins.

4. Paragnathi only present on the basal region of the proboscis in extrusion, or absent.

Nereis (*Eunereis*) *longissima*, Johnston. Paragnathi VI present in some. Maxillary and basal regions of proboscis mapped into areas by grooves. Cirri short. Length, a foot or more.

Genus LX.—Nereis, *Linnæus*, 1731. (Char. emend.)

Cephalic lobe somewhat rectangular at the base, on which the four eyes are situated, whilst the anterior part is narrower and bluntly conical. Two tentacles; palpi two, lobate, with a terminal process. Nuchal organs primitive, consisting of a ciliated surface in direct contact with the exterior (Racovitza). Body sublinear, convex dorsally, flattened ventrally, slightly diminished in front, more distinctly tapered posteriorly, where it terminates in two caudal cirri below the vent. The first segment bears only four tentacular cirri. Feet subequal throughout, sometimes foliaceous, with spines and falcate bristles. Third and all succeeding feet biramous. Superior division of the foot bifid, the spine not reaching the surface, and the bristles issuing from the base of the fork. Proboscis armed with right and left maxillæ, strongly denticulated, and horny dentiform processes (paragnathi) variously arranged, provided with powerful muscles, and protrusible. Œsophagus with a pair of glands; stomach simple and intestine straight.

1. Nereis pelagica, *Linnæus*, 1756. Plate LII, figs. 1 and 2; Plate LX, figs 6 and 6 *a*—head; Plate LXXI, figs. 7–7 *i*—feet; Plate LXXX, figs. 25–25 *b*—bristles.

Specific Characters.—Head having a triangular anterior and a rectangular posterior region with four black eyes of considerable size; the pairs wide apart and obliquely situated. Tentacles and tentacular cirri of moderate length and typical. Body firm and rounded, with a peristomial segment about twice the breadth of the succeeding; segments sixty to eighty. Colour iridescent greenish-brown, fawn, reddish-brown, or yellowish-brown, the central dorsal vessel forming a thin red line except at the moment of contraction. Opposite each foot are yellowish-white grains, and often the sides and feet generally present a greenish or olivaceous tint. Under surface paler, iridescent. Anus often marked by a whitish opacity. The feet anteriorly are somewhat blunt and bulbous at the tip. The first foot has three lobes, a dorsal, a ventral, and an intermediate setigerous process which bears both homogomph and heterogomph bristles. The feet vary

little after the three lobes and the two setigerous processes are complete, except that behind the anterior third the tips of the lobes become more pointed, and posteriorly the cirri are elongated. The posterior feet also diminish in size and become more transparent, and the heterogomph bristles, both upper and lower, are proportionally stronger.

Proboscis of the typical two regions in extrusion (Fig. 58). From the maxillary project the two dark brown, horny jaws, having five to seven teeth. Dorsally behind them is on each side a crescent of dark brown paragnathi (II) formed of three rows of points. Between these are two paragnathi (I), one anterior to the other. On the eminence in front of each palpus is a group of four long teeth which probably correspond with VI, whilst a narrow triangle with the apex in front probably represents V, though devoid of paragnathi. Slightly behind the foregoing a line of paragnathi (VII) trends to the ventral surface and joins VIII. Ventrally a belt of maxillary prickles (IV), broader at the outer or ventral edge, occurs below the jaws in a similar position to the dorsal crescents, but with a different arrangement of the prickles. In the median line is a transverse belt of paragnathi (III), which in some forms a central group of about eight and a short lateral crescent of three prickles. The basal division of the organ has a conspicuous belt (VIII) extending more or less from the dorsal elevations across the lozenges formed by the lines of the region. The larger prickles are generally in a single row in front, whilst a belt of more numerous, minute prickles—diminishing from front to rear—occurs behind.[1]

Epitokous form.—In the *males*, which are found from January to June, the head is wide and the eyes are larger; the dorsal cirri of the first seven feet are thickened throughout the greater part of their length, the short tip being filiform. The ventral cirrus in the first four or five feet is also enlarged. At the seventeenth foot the change from the nereid to the heteronereid condition commences with increased vascularity; a dorsal lamella, a ventral, a large inferior setigerous lamella, and a superior subsetigerous lamella all being developed, with fan-like groups of swimming bristles. The dorsal cirrus has a row of prominent papillæ along its lower edge. Sperms extend far forward to the anterior or nereid region. The colour is greenish anteriorly, posteriorly pale or cream-coloured from the sperms, except in those first mentioned, which are pale anteriorly. The tip of the tail is pinkish from the vessels.

Female.—Deep russet-brown and iridescent in February from ova, which are of a faint salmon-colour. The tips of the palpi are dull brownish-orange like the proboscis. The same whitish patch occurs in front, between and behind the eyes. In September the feet become very vascular, so as to give a deep red aspect to the sides, whilst their tips are pale. At St. Andrews pelagic females have been found, but none have been observed from other British localities.

Synonyms.

1746. *Nereis pelagica*, Linnæus. Fauna Suec., Ed. 2, p. 2096.
1758. „ „ idem. Syst. Nat., Ed. 10, i, p. 654.
1762. „ „ Baster. Opusc. subsec., Tom. ii, p. 133, Tab. 6, f. 6.

[1] Grube characterizes the proboscis of the group containing *N. pelagica* and *N. diversicolor* as having VI of four or five in the form of a quadrangle or a cross, and V absent.

1767. *Nereis pelagica,* Linnæus. Syst. Nat., ed. 12, i, pt. 2, p. 1086.
1770. „ *ferruginea,* Gunner. Skrift. Kjöbenh. Selskab, x, p. 169, Tab. e, f. 10.
„ *Söe-Skollorm,* Ström. Ibid., x, p. 9, Tab. b, iv.
1771. *Die warzige Nereide,* O. F. Müller. Von Würmern, p. 144.
1776. *Nereis verrucosa.,* idem. Zool. Dan. Prodr., p. 217.
„ „ *fimbriata,* idem. Ibid., p. 217.
1780. „ *verrucosa,* Fabricius. Fauna Grönl., p. 292.
1791. „ *pelagica,* Linnæus. Syst. Nat. (Gmelin), ed. 13, i, pt. 6, p. 3116.
1806. „ „ Turton's Linnæus, iv, p. 86.
„ „ *fimbriata.* Ibid., iv, p. 86.
1807. „ *pelagica.* Ibid., Brit. Fauna, p. 135.
1817. „ „ Stewart. Elements, i, p. 390.
1820. „ *subulicola,* Leach. Brit. Mus. Coll.
1825. „ *margaritacea,* De Blainville. Dict. Sc. Nat., xxxiv, p. 433.
„ „ *pelagica,* idem. Ibid., p. 433.
1827. „ „ Encycl. Méth.,[1] Vers, i, p. 134, Tab. lv, f. 21—23.
„ „ *fimbriata.* Ibid., p. 134, Tab. lv, f. 18—20.
1828. „ *margaritacea* and *pelagica,* De Blainville. Dict. Sc. Nat., lvii, p. 470.
„ *Lycoris margaritacea,* Johnston. Zool. Journ., iv, p. 419.
„ „ *viridis,* idem. Ibid., p. 420.
1830. *Nereis pelagica,* idem. Ann. Nat. Hist., iii, p. 290, pl. vi, f. 1.
1833. „ *margaritacea,* Aud. & Edw. Ann. Sc. Nat., t. xxix, p. 217.
1834. *Lycoris margaritacea,* Johnston. Loud. Mag. Nat. Hist., vii, p. 230, fig. 42.
1840. *Nereis pelagica,* idem. Ann. Nat. Hist., v, p. 172, figs. 3, 4.
1842–3. „ „ Œrsted. Kroyer's Nat. Tids., p. 115.
1843. „ „ idem. Annul. Danic. Consp., p. 21, f. 72, 75, 76.
„ „ „ H. Rathke. Nova Acta Acad. Leop.-Cur., xx, l, p. 158, Tab. viii, f. 1—3.
„ „ „ Œrsted.[2] Grönl. Annul. Dorsibr., p. 175, f. 52, 53.
1844. „ „ Thompson. Rep. Brit. Assoc., 1843, p. 273.
1844–5. „ „ Œrsted. Kroyer's Nat. Tids. (Drϕbak), p. 408.
1847. „ „ Frey and Leuckart. Beitr., p. 154, Tab. ii, f. vii.
1849. „ „ Leuckart. Arch. f. Naturges., xv, i, p. 207.
1851. „ „ Sars. Nyt Mag. f. Naturvid., vi, p. 209 (Reise Lofot. og Finmarken).
„ „ „ Grube. Fam. Annel., pp. 48 and 125.
1853. „ *fulgens,* Dalyell. Pow. Creat., ii, p. 153, pl. xxii, f. 6—8.
1858. „ *pelagica,* Grube. Sibirien's Annel. Mém. Sav. etrang., St. Pétersburg, viii, p. 4.
1860. „ „ Packard. Canad. Nat. and Geol., vii, p. 418.
1863. „ „ Stimpson. Ann. Greenl., in Proc. Acad. Nat. Sc., Philad., p. 140.
1865. „ „ Johnston. Cat. Worms Brit. Mus., pp. 148 and 341.
„ „ *diversicolor,* idem. Ibid., p. 152 (excl. syn.).
„ „ *fimbriata,* Johnston. Cat. Worms Brit. Mus., pp. 155 and 341.
„ „ *pelagica,* De Quatrefages. Annel., i, p. 542.
„ „ *margaritacea,* idem. Ibid., p. 510.
„ „ *Reynaudi,* idem. Ibid., p. 519.

---

[1] Bruguière, Lamarck, and Deshayes.

[2] It has not been thought necessary to quote a *résumé* in Kroyer's 'Naturh. Tidskrift,' Bd. iv, 2 Hefte.

1865. *Nereis Bowerbanckii,* idem. Ibid., p. 541.
„ „ *pelagica,* Carrington. Annel. Southport, p. 8.
1866–9. „ „ Packard. Mem. Bost. Soc. Nat. Hist., i, p. 294.
1867. „ „ Malmgren. Annul. Polych., p. 47, Tab. v, f. 35.
1868. „ „ Ehlers. Börstenw., ii, p. 511, Taf. xx, f. 11—20, and var. *lunulata,* p. 511.
1870. „ „ Grube. Arch. f. Naturges., Bd. xxxvi, p. 308.
„ „ *margaritacea,* idem. Ibid., p. 314.
1873. „ *pelagica,* Verrill. Invert. Viny. Sound, i, pp. 319, 591, pl. xi, f. 52—55.
„ „ „ Kupffer. Exped. Ostsee, 'Pommerania,' p. 150.
„ „ „ Sars. Bidrag Christ. Fauna, p. 22.
1874. „ „ and *heteronereis,* Möbius. Die Zweite deutsch. Nordpol., p. 254.
„ „ „ Grube. Jahresb. Schles. Gesell. for 1873, p. 70.
„ „ „ Smith and Harger. Trans. Conn. Acad., iii, pp. 12, 16, 20.
„ „ „ McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 198.
„ „ „ Malm. Göteb. vet. o. vitt. Handl., xiv, p. 83.
1875. „ „ McIntosh. Invert. and Fishes St. Andrews, p. 122.
„ „ „ idem. Proc. Roy. Soc., vol. xxv, p. 217.
„ „ „ Möbius. Jahresb. Comm. deutsch. Meer. ii, p. 168.
1878. „ „ Lenz. Jahresb. Comm. deutsch. Meer. iv, Anhang., p. 13.
„ „ „ Marenzeller. Denks. k. Akad. Wien., Bd. xxxv, p. 396.
1879. „ „ idem. Ibid., t. xli, p. 122 (Sudjap. Ann.).
„ „ „ Verrill. Check. List, U.S. Comm. F. and F., p. 8.
„ „ „ Tauber. Annul. Danic., p. 96.
„ „ „ McIntosh. Trans. Linn. Soc., 2 ser., Zool., vol. i, p. 503.
„ „ „ Hansen. Nyt Mag. f. Naturvid., xxiv, p. 268.
1881. „ „ Leslie and Herdman. Proc. R. Phys. Soc. Edin., vol. vi, p. 274.
„ „ „ Horst. Niederl. Arch. Zool., Suppl. Bd. i, p. 12. (Wm. Barent's Exped., 1878.)
1883. „ „ Levinsen. Vidensk. Meddels., 1881, p. 234.
1884. „ „ Webster and Benedict. Rep. U.S. Comm. F. and F., p. 718.
1885. „ „ McIntosh. Annel. 'Challenger' (t. xii), p. 216.
„ „ „ Carus. Fauna Medit., p. 218.
1886. „ „ Harvey Gibson. Proc. Lit. Phil. Soc. Liverp., vol. xi, p. 154.
1887. „ „ Jeffrey Bell. Proc. Zool. Soc. Lond., p. 3.
1888. „ *procera,* De St. Joseph. Ann. Sc. Nat., 7e sér., t. v, p. 266, pl. xi, f. 132.
1889. „ *pelagica,* Marenzeller. Archiv f. Naturges., 1889, i, p. 128.
1890. „ „ Giard. Bull. Soc. Sc. Fr. Belg., t. xxii, p. 77.
„ „ „ Malaquin. Annél. Boulon, p. 29.
1891. „ „ Hornel. Trans. Biol. Soc. Liverp., vol. v, p. 241.
„ „ „ Biedermann. Jenaische Zeitschr. f. Nat., Bd. xxv, p. 450.
1892. „ „ (eyes) Andrews. Journ. Morph., p. 178, pl. ix, f. 13.
1893. „ „ Levinsen. Vidensk. Ud. "Hauchs," p. 329.
1895. „ „ De St. Joseph. Ann. Sc. Nat., 7e sér., t. xx, p. 221, pl. xiii, f. 40.
1898. „ „ Michaelsen. Grönl. Annul. (Zool. Ergebn. IX), p. 126.
„ „ „ De St. Joseph. Ann. Sc. Nat., 8e sér., t. v, p. 293.
1901. „ „ Whiteaves. Geol. Surv. Canada, No. 722, p. 80.
1902. „ „ McIntosh. Ann. Nat. Hist., ser. 7, vol. x, pp. 256 and 258.
1904. „ „ Allen. Journ. M. B. A., N.S., vol. vii, p. 224.

1906. *Nereis pelagica,* De St. Joseph. Ann. Sc. Nat., 9e sér., t. iii, p. 215.
1908. „ „ Horst. Tijdschr. Nederl. Dierk. Vereen (2), xi, p. 143.
1909. „ „ Elwes. Journ. M. B. A., n.s., vol. viii, p. 351.
„ „ „ Moore. Proc. U.S. Nation. Mus., vol. xxxvii, p. 137.

Forma Epitoca. Male.

1800. *Die faserige Nereide,* O. F. Müller. Wurm-Arten., p. 144, Tab. viii, f. 1—3.
1840. *Nereis renalis,* Johnston. Ann. Nat. Hist., v, p. 176.
1843. *Heteronereis arctica,* Œrsted. Grönl. Annul. dors., p. 179 (27), f. 50*, 51, 60, 65, 68, 70*.
„ *Nereis grandifolia,* H. Rathke. Beiträge Fauna Norweg., p. 155, Tab. vii, f. 13, 14.
1849. „ „ R. Leuckart. Archiv f. Naturg., Jrg. 15, Bd. i, p. 207.
1851. „ *renalis,* Williams. Rep. Brit. Assoc., p. 197.
1865. *Heteronereis renalis,* Johnston. Cat. Worms Brit. Mus., p. 163.
„ „ *arctica,* De Quatrefages. Annel., i, p. 566.
„ „ *renalis,* idem. Ibid., p. 580.

Female.

1842–3. *Heteronereis arctica,* Œrsted. Kroyer's Nat. Tids., p. 117.
„ „ *assimilis,* idem. Ibid., p. 117.
1843. „ „ idem. Grönl. Annul. Dorsibr., p. 180, f. 54, 61, 72.
„ ? *Nereilepas fusca,* idem. Annul. Danic. Consp., p. 21, f. 49, 50.
1853. *Nereis denticulata,* Stimpson. Invert. Grand Manan, p. 33, f. 23.
1865. *Nereilepas fimbriatus,* De Quatrefages. Annel., i, p. 559 (excl. syn.).
„ *Heteronereis assimilis,* idem. Ibid., p. 566.
„ „ „ Malmgren. Nord. Hafs-Annul., p. 108, Tab. xi, f. 15 B, C.
1866–69. „ *arctica,* Packard. Mem. Bost. Soc. Nat. Hist., i, p. 293.
1874. „ *grandifolia,* Malm. Göteb. vet. o. vitt. Handl., xiv, p. 84.

Male and Female.

1865. *Heteronereis grandifolia,* Malmgren. Nord. Hafs-Annul., p. 108, Tab. xi, f. 15 ♀, f. 16, B, B′, C ♂.
1867. „ „ idem. Annul. Polych., p. 60, Tab. iv, f. 31.
1873. „ „ Sars. Bidrag Christ. Fauna, p. 23 (sep. copy).

Habitat.—Abundant in tubes under stones between tide-marks on both shores of Britain and Ireland; under layers of slaty rocks, in fissures of sandstone, in sandy mud, and under old limpets. It is less common in the Channel Islands, where medium or small examples are found only in chinks of rocks and under Balani and Ascidians in the Gouliot Caves, Sark, a single small example of *Nereis cultrifera,* and one or two of *N. Dumerilii* accompanying them. Occasionally the tube formed by it in fissures of sandstone is not half the length of its body.

Many young forms occur on the tangle-blades (*Laminaria saccharina* and *L. digitata*), to the surface of which their tubes are attached, and also on *Delesseria sanguinea* in the laminarian region. It extends to the coralline ground off the East coast, and now and then it takes possession of an empty tube of other forms, such as *Thelepus.*

It ranges from the shores of France, though De St. Joseph found it but seldom at

Dinard, to the south of Halifax, Nova Scotia; Japan (Marenzeller); the eastern shores of Siberia near Amon (Grube); Behring's Sea (Marenzeller); and var. *lunulata*, Ehlers, to the Strait of Magellan. Large examples were procured by the 'Valorous' in 20 fathoms in the Arctic seas. Specimens were also found on floating seaweed off Gough's Island, South Atlantic, long. 9° 49′, lat. 40° ½′ (Prof. Dickie, Aberdeen), and a variety from Kerguelen.

This cosmopolitan species thus extends from the British shores to those of northern and southern Europe, the Mediterranean, the Atlantic shores of America, the Pacific, the Arctic, and the Antarctic seas.

Head (Plate LII, fig. 1, and Plate LX, figs. 6 and 6 *a*) somewhat rectangular posteriorly and bluntly triangular in front. Four black eyes of considerable size are situated on the rectangular region. The pairs are wide apart and obliquely placed,—that is, the anterior pair is wider apart than the posterior. A pair of short tentacles occurs on the truncated anterior end of the head. From the lateral regions of the snout the palpi project forward and outward as large tumid processes in contraction, and having a terminal articulation which is retractile within the basal region. From the anterior part of the peristomial segment on each side spring two pairs of tentacular cirri, which form a kind of cluster, though the anterior pair arises somewhat lower than the posterior. Each has a long dorsal cirrus and a shorter ventral cirrus, with a basal cirrophore, the longest being the dorsal of the second pair. The peristomial segment is about double the breadth of the average segment, and probably the tentacular cirri indicate that the segment is double, the appendages having been shifted forward.

Body 4—8 ins. long, slightly diminished anteriorly, then remaining of a uniform diameter for some distance, and again narrowing to the tail, where it terminates in a prominent vent, beneath which are two long cirri. The segments are convex dorsally, flattened ventrally, and of nearly uniform breadth and appearance. In colour it is of an iridescent greenish-brown, reddish-brown, or yellowish-brown, the dorsal vessel forming a thin, dull red line, except at the moment of transmission of the blood. Opposite each foot in some are yellowish-white grains.

There is considerable variety in the coloration, though most show a brownish or fawn-colour dorsally with a greenish or olivaceous shade at the sides and feet. In some a dark grey stripe occurs along each side dorsally at the bases of the feet. Many of the larger specimens have calcareous deposits in circular patches in the skin of the dorsum. The under surface is of a paler, iridescent, or roseate hue, and the anus is often marked by a whitish opacity.

Proboscis.—In extrusion the organ presents dorsally (Plate LX, fig. 6) two regions —a distal or maxillary and a proximal or basal—mapped out into distinct and somewhat lozenge-shaped areas by linear depressions. From the distal project the two curved horny maxillæ or jaws, with five teeth. On the dorsal margin behind them (Area II) is a crescent of dark brown horny teeth, formed of a posterior curved row, another which lies within (in front of) the former, and a third short row composed of four small prickles at the inner border in front. In the central line (Area I) between these are two teeth, one in front of the other, on an elevation. In front of the palpi is a prominence on each side (VI) with four long prickles or teeth, and slightly behind each a line of prickles (VII and

VIII) trends to the ventral surface. Area V seems to be represented by an acutely triangular space between and behind VI. Ventrally (Plate LX, fig. 6 *a*) a belt of prickles (IV), broader at the outer or ventral edge, occurs below the jaws in a corresponding position to the dorsal crescents, though with a different arrangement of the constituent prickles. In the median line on an eminence is a central group of small prickles (III), about eight in number, and on each side a short lateral crescent of three prickles. The band of points (VII and VIII) from the dorsal elevation with the four horny teeth extends across the ventral surface, the arrangement of the prickles being somewhat modified by the mapping out of the area by the depressed lines. The general effect, however, is to produce a belt, with the larger prickles, in some cases, forming an anterior row, and a belt of more numerous small prickles behind, the smallest points being posterior. In some of the areas marked off by the depressed lines two or three of the large points occur in front and a group of the smaller behind, and an indication of symmetry is seen especially in the lateral areas. Little variation is found in the arrangement and proportional size of the paragnathi.

The food consists of delicately branched Algæ, coarse fragments of Fuci and other sea-weeds, sandy mud, sponge-spicules, small ova, bristles of other polychætes—probably swallowed with portions of the bodies. The fæcal masses are enveloped in a coating of mucus.

The first foot (Plate LXXI, fig. 7) has dorsally a prominent edge ending in the cirrus, then a large lobe smoothly rounded distally. Beneath is a somewhat pointed conical setigerous process bearing two tufts of bristles and a spine, the upper tuft having the terminal pieces long and serrated, with the exception of one with a short serrated terminal process. The lower group consists of bristles with short terminal pieces. Inferiorly is a lobe of similar shape externally to the dorsal, but as the ventral cirrus springs from the base close to the body, it is more conspicuous and has a slightly sinuous ventral margin. The second foot is more or less like the first, the elevation at the base of the dorsal cirrus being more prominent, but the third has two lobes above the conical setigerous process, viz., a smaller upper, and a lobe resembling the dorsal of the first foot. Between them, however, is a tuft of bristles with long spear-tips. There are now two spines. The setigerous region remains conical, and the inferior lobe has increased in bulk. The dorsal cirrus is shorter.

The tenth foot (Plate LXXI, fig. 7 *a*) presents in the dorsal division two nearly equal lobes with the bristles between, the dorsal bearing the cirrus, whilst the ventral division consists of the conical setigerous and a rounded ventral lobe with a cirrus at its base. All the bristles in the upper division have long slender tips. Those of the ventral division form two groups. In the upper group most have long tips, but three or four have short tips. In the lower group a few of the upper have long terminal pieces, the rest short tips (Plate LXXX, fig. 25).

The thirty-seventh foot (Plate LXXI, fig. 7 *b*) has the two lobes of the upper division considerably more pointed, so that they form elongated cones. The shafts of the bristles have greatly increased in strength, and one or two with short tips and strong shafts are present. In the inferior division the two groups are equally differentiated, those with slender shafts having long slender tips (Plate LXXX, fig. 25 *a*), whilst those with stout

curved shafts have short tips. The conical setigerous region is less prominent than the dorsal lobes. The ventral lobe is also pointed and more prominent than the setigerous region. The cirrus is shorter than the latter, and the foot generally is less massive.

The fifty-seventh foot (Plate LXXI, fig. 7 *c*) has considerably diminished in general bulk, and the lobes are more acute. This diminution and increased transparency make both the spines and bristles very prominent in mounted preparations; the deep black of the former and the golden hue of the stout bristles with the short tips are characteristic. Both dorsal and ventral cirri are proportionally longer and more slender, the former, as in the thirty-seventh foot, far exceeding the latter. While this foot closely resembles in general configuration the thirty-seventh, except that the dorsal cirrus is longer, and the proportions of the two upper lobes are in contrast with the lower, the bristles with the short tips both in the upper and lower groups are proportionally stronger.

An interesting account of the minute structure of the bristles of this species is given by Schepotieff,[1] who shows that the rows of cross-bars are continuous with the upper longitudinal streaks.

Just in front of the tail the foot presents a still further diminution in size, the hump of the dorsal outline at the base of the cirrus is marked, the upper lobe is smaller, and it and the others have less acute tips. The dorsal cirrus is much lengthened, and the ventral projects beyond the adjoining lobe. The vascularity of the foot generally is well shown in these translucent organs. The bristles retain the characters already indicated.

In this species the ventral longitudinal muscles are more elongated transversely, and have a longer and more pointed dorsal (external) fold than in *Nereis diversicolor*.

In a specimen from St. Andrews in which injury had occurred, the third and fourth feet of the right side were in process of reproduction. In these the dorsal and ventral cirri were proportionally large, appearing more conspicuous than the lobes, yet all were new. Many examples show reproduction of the tail. Prof. Jeffrey Bell, again, has recorded an example from Guernsey in which the tail was bifid.

Habits.—Though the majority of examples obtained from deep water off St. Andrews are small, very few reaching medium size, large specimens are found in the stomach of the cod and also in that of the flounder. In the whole series of British examples no finer ones occur than those from St. Andrews. The other features in the habits of this form are indicated under those of the family.

This species has been supposed to bore in wood and also in telegraph cables. Thus Dr. Carpenter forwarded a specimen of medium size along with a portion of a telegraph cable (1874). So far as could be observed, however, the perforations were due to other forms.

Reproduction.—Specimens having the general form of *Iphinereis fucicola*, Œrst, are not infrequently met with at low water early in February, or even as early as the 18th January. The anterior region of the body resembles that of *Nereis pelagica typica*, only the head and palpi are of a richer green with a slight tint of blue, and the tentacles are bluish-green, thus contrasting with the dull orange proboscis, which is beautifully marbled or cut into areas by pale streaks. The terminal processes of the palpi are paler. The

[1] ‘ Zeitschr. f. wiss. Zool.,’ Bd. lxxiv, p. 21, Taf. xxxiv, figs. 5—15, 1903.

brownish-purple eyes are larger, have lenses, and a median patch of white occupies the region behind the posterior pair and passes forward as a wedge in front. A brown patch exists behind the posterior pair, mimicking a third pair on each side. A little white also occurs to the exterior of the anterior eye. The prickles of the proboscis agree with the typical form. The anterior feet, whilst also resembling those of *Nereis pelagica* generally, have the dorsal cirri of the first seven enlarged in the middle. At the seventeenth foot the changes in the lobes of the feet commence with increased vascularity, and this increases in the posterior feet. The coloration above alluded to (greenish, with a slight tinge of red) extends at least as far backward as the seventeenth foot, gradually fading behind, all the feet being paler than the body. The dorsal blood-vessel enlivens the region, and by-and-by fine, dark-greenish, granular transverse lines mark each segment, but the posterior region is only granulated. A little later, as in the beginning of March, those with the nuptial form as described have the sperms extending far forward—in front of the region with the modified feet. The body behind the greenish anterior region is pale—whitish or cream-coloured—from the sperms; indeed, some specimens are whitish up to the peristomial segment, laterally and ventrally. The tip of the tail is slightly pinkish from the blood-vessels.

These forms are likewise found in June and July under stones near low water-mark, or in runlets of water at half-tide. They swim freely about in the water assisted by the large lamellæ. In some many of the feet are only half the size of the others, having apparently either been later in assuming the change, or in process of reproduction. The dense whitish mass which exudes on rupture consists of sperm-cells not yet matured. The cells are not entirely granular throughout.

In a male with typical paragnathi (Plate LII, fig. 2), procured on the 18th January, the first fifteen feet are more or less normal, with the exception of the enlargement of the dorsal cirrus in the first seven segments and the slight enlargement of the ventral cirrus in five. The sixteenth foot has a minute flap close to the internal border of the dorsal cirrus, and a like rudiment occurs in a similar position to the ventral cirrus. A rudiment of a lamella also appears posteriorly at the tip of the inferior setigerous process. At the seventeenth foot the three lamellæ or flaps are larger, but the bristles (homogomph) are unaltered. The heterogomph bristles are absent. The full development of the heteronereid foot occurs in the thirty-seventh and neighbouring feet (Plate LXXI, fig. 7 *f*), in which the lamella on the ridge internal to the dorsal cirrus is fan-shaped. The dorsal cirrus is rather long with nine or ten papillæ on its lower border. Each papilla has an opaque mass internally. The dorsal lobe is lanceolate and comparatively short, the cirrus extending more than double its longer diameter beyond it. The dorsal setigerous process bears only swimming bristles (Plate LXXX, fig. 25 *b*). The lobe beneath has a short conical tip, and a heel projecting beyond its base internally. The inferior setigerous process has a large fan-shaped lamella posteriorly. The bristles are of two kinds in the specimen, viz., the dense fan of swimming bristles, and a few of the atokous forms, both homo- and heterogomph. These in all probability would soon be shed. The ventral lobe is tongue-shaped. The ventral cirrus has a fan-shaped lamella internally and a pointed one externally.

The average number of nereid feet in front of the heteronereid region seems to be

about sixteen, though sometimes seventeen or eighteen are present. Levinsen (1883) likewise mentions that the first sixteen are unaltered.

The fifty-seventh foot (Plate LXXI, fig. 7 *g*) differs little from the preceding except perhaps in the narrower dorsal and more attenuate dorsal and ventral lobes, and the diminished number of crenations on the under surface of the dorsal cirrus. These crenations disappear before the eightieth foot, which presents a somewhat fusiform dorsal cirrus and a tapering ventral cirrus.

The eightieth foot (Plate LXXI, fig. 7 *h*) shows considerable modification of the parts, though the plan is similar to the fifty-seventh. The dorsal cirrus is now smooth.

In a large epitokous example procured by Mr. Gray in the stomach of a salmon at Berwick-on-Tweed, a curious transverse mark, simulating a pit on one side, occurred behind each posterior eye.

In certain examples from the deeper water of St. Andrews Bay the paragnathi of the basal segment of the proboscis in extrusion present certain variations. Thus the anterior row of large isolated points is very regular and distinct, each occupying its area, whereas the smaller teeth behind are very minute and at first sight almost invisible. The widening of the head and the increase in the size of the eyes are often marked.

In a pelagic male the dorsal cirri of the first seven segments are much enlarged, the filiform tip only extending from the bulbous end of the cirrus. Moreover, the ventral cirri have the same shape. These curious cirri thus approached those anteriorly in *N. Dumerilii*.

The first foot in an epitokous male more or less agrees with that in the atokous form, consisting of a single lobe superiorly and another below the setigerous lobe with the single spine. In this, a large specimen, the dorsal and ventral lobes are bluntly rounded and short, but in the smaller forms (males) they are more elongated, though still with a bluntly rounded tip. The dorsal cirrus in the large example is long and tapering (Plate LXX, fig. 7) with a slight thickening of its base dorsally, extending about a third of the length of the process. The dorsal and ventral lobes form short, bluntly rounded cones. The intermediate setigerous lobe ends in a short bifid cone, bearing superiorly bristles with long tapering tips and inferiorly some with shorter tips, considerably longer, however, than the ordinary types.

In another epitokous male the changes are only evident in the twenty-third foot, though a small process occurs at the base of the ventral cirrus of the twenty-second foot. In this foot (twenty-third) a process appears at the base of the dorsal cirrus, and the cirrus itself is clavate. The dorsal lobe is not much altered. The superior setigerous lobe bears a dense tuft of the sabre-like swimming bristles and is closely connected with the lobe beneath it, which has a nearly normal outline, but in addition a large translucent fan-shaped process projects downward behind the inferior setigerous lobe. The latter is elongated, and a dense series of swimming bristles is developing, whilst the shafts of two of the stronger bristles of the original series with short tips still remain. This lobe has a large foliaceous and translucent lamella projecting from its outer and upper border. The ventral lobe is tongue-shaped, and the ventral cirrus has a flattened leaf-like expansion on each side of its base.

The *Johnstonia prolifera* of De Quatrefages[1] is a Heteronereis of this or other species of *Nereis*. An epitokous example of this form is in all probability the *Nereis bipinnata* of Montagu (MS. Drawings, Linn. Soc., Plate XXIX, fig. 3, 1808).

Female Heteronereid.—In September the feet of the female become very vascular, so as to give a deep red appearance to the sides (Plate LII, fig. 1), and as the tips of the lobes of the feet are pale, the aspect is the more striking. The perivisceral cavity is loaded with eggs which have one large oil globule. They are opaque whitish, and the majority are of equal size. There is as yet no indication of structural change in the feet or other organs.

At the beginning of February large females show a somewhat deeper and beautifully iridescent russet-brown of the body, probably from the tint of the eggs, which are faint salmon or buff coloured in mass. The head and tentacles are of the same greenish hue as the males, the palpi having the tips dull brownish-orange like the proboscis. The same whitish patch (though less developed) occurs behind, between and in front of the eyes. The latter are not enlarged. The armature of the proboscis is typical. The feet show no evident change in front and apparently not much posteriorly, their extremities being pale. The ova are of comparatively large size. The *Nereis ferruginosa* of Montagu (MS. Drawings, Linn. Soc., Plate LII, fig. 2) may represent this stage, and it appears to be the *Nereis fulgens* of Dalyell.

Before the heteronereid condition is developed, the female *Nereis pelagica* is thus distinguished by the lustrous deep brownish or bronzed colour just mentioned, and the size is frequently larger than that of the male. As the ova develop and distend the posterior region the latter assumes a somewhat pale hue, and by-and-by also the body generally becomes somewhat shorter and broader from contraction. The change of colour does not at first much affect the general aspect, and no sign of alteration in the structure of the feet is visible externally, but they are highly vascular, the dorsal edge of each being connected with the body by a reticulated bar of blood-vessels. The eggs at this stage are dull yellowish and minutely granular, and have none of the large globules of a subsequent stage; moreover, in the lustrous brown condition of the adult they are more minute. The eyes as yet show no perceptible change.

The next stage is characterized by the lustrous pale-greenish condition of the body from the twentieth foot backward, whilst the brownish-olive hue remains in front. The head has a pale trifid mark between the eyes, the median spur going forward. The eyes do not show marked alteration, but the anterior dorsal cirri have a slight enlargement at the base. The pale region is loaded with greenish-white ova measuring $\frac{17}{100}$ mm. The vascularity of the feet is pronounced.

Then the deep brownish or olive colour anteriorly gives way to a paler greenish brown, the posterior region becoming still more pale as the eyes enlarge. Various isolated and fixed black specks appear, but whether in the gut or body-wall is not clear. The pallor makes the blood-vessels of the feet and of the dorsum conspicuous. The head and anterior region retain in some the brownish hue mingled with green for some time, but the tentacles and tentacular cirri are pale greenish.

At a further stage (24th February) the anterior region of nineteen segments is olive

[1] 'Ann. Sc. Nat.,' 3e sér., t. xiv, p. 350, pl. viii, fig. 1, August, 1850.

green, and the palpi, tentacles, and tentacular cirri are pale green, the head itself being olive with the white trifid mark posteriorly. The pelagic posterior region is developing, and it is pale, while the feet are vascular. The ova are pale greenish with numerous large globules amongst the smaller.

The epitokous females hitherto observed are about the size of the males, though one or two are larger, and all possess the triradiate band between the eyes and a pale peacock-green colour anteriorly. The first five dorsal cirri are enlarged at the base and the ventral cirri of the same feet are slightly swollen. In the altered posterior region the dorsal cirri are also somewhat dilated towards the base (cirrophore), and have inferiorly on the enlarged region low papillæ or warts, to which groups of stalked Infusoria and also slender filaments of Algæ adhere. Thus, although the prominent row of papillæ which projects from the lower edge of the cirrus in the male is absent, there is a tendency to such growths. The ventral cirri present even a more marked tendency to these growths, about four prominent cones being found on the ventral edge, and they also

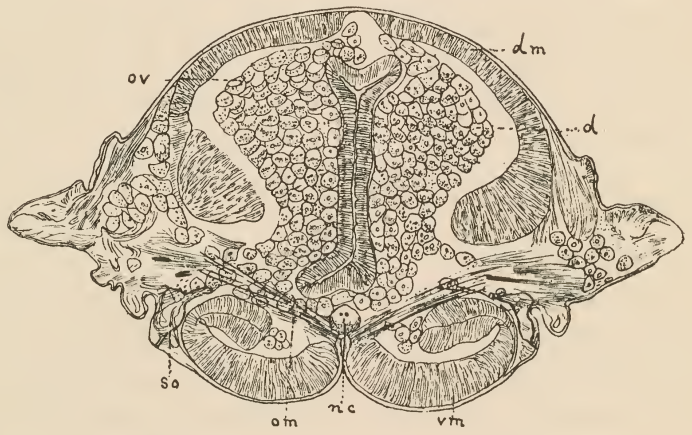


Fig. 65.—Transverse section (made by Capt. F. H. Stewart, M.D.) of a nearly ripe *Nereis*. *ov.* Ova. The other letters as before.

have Infusoria and Algæ attached. The swimming bristles in the posterior region are very large. Ventrally the same marked distinction between the anterior and posterior regions of the body occurs as in the male, the anterior region being pale, a slightly greenish shade only being visible in the head-region, whereas the posterior is of a deep pinkish purple. This hue is apparently not due to the muscles, as during the movements of the animal the intensity varies, as if from vascular changes.

The heteronereid feet of the female agree generally in the position and shape of the lamellæ and other parts with the male.

The changes which ensue in the body of the ripe female *Nereis* are indicated in the accompanying section (Fig. 65).

Two examples, about 5 ins. in length and apparently answering to this species in the heteronereid condition, were procured by Mr. Gray in October, 1894, in the stomach of a salmon at Berwick-on-Tweed. Both were females, still with a few dark-coloured ova in groups at the bases of the feet. The condition of the jaws and paragnathi, which were unusually large, showed that these were old specimens.

On the 28th March three Heteronereids were procured at the margin of the beach, near high water-mark. They swam swiftly and gracefully through the water. No sperms could be observed in the vessel, which contained a large quantity of water.

In contrast with the condition in this species it is interesting to find that in the Japanese *Ceratocephale osawai* of Izuka,[1] the epitokous form presents no marked change in the structure of the feet though they increase in size, and develop swimming bristles. Moreover, a considerable region posteriorly shrivels even before swarming, and is cast off by the pelagic anterior moiety, which discharges its sexual elements by the ruptured posterior end. The distension of the anterior region of the epitokous *Nereis pelagica* and the more slender and mobile posterior region with its modified feet thus foreshadows the condition in the former.

Habits.—Like other Nereids this species in confinement forms tough tubes of secretion on the sides of vessels, and the same habit occurs in the early stages of the epitokous condition.

Development.—The development of *Nereis pelagica* is still in need of further elucidation, though it probably closely corresponds with that of other forms, such as *N. Dumerilii* and *N. diversicolor*—indeed, the very early stages may have been confounded with these. In the bottom-net at the beginning of November many small ova of a dull yellowish hue, and larvæ of the same tint rotating by aid of cilia, are captured, but their relationships are doubtful. By transmitted light the larvæ are yellowish green. Externally are more minute cells, within are globules of yolk.

A young *Nereis pelagica* of forty bristled segments and measuring 8 mm. was obtained at Lochmaddy in August. In this the tentacles are larger in proportion than in the adult, whilst the tentacular cirri are shorter. The longest (in spirit) extends to the fourth segment. The eyes are wider apart and have the long axis longitudinal. The bristles, though small, and with indistinct cameræ, appear to follow the normal type. This is probably the young of the year, just as another procured at St. Andrews in September probably is. The latter has forty-four bristled segments. The eyes are more rounded. Attached to the twenty-eighth foot on the right is a parasitic body of a clavate outline (like a *Demodex*) with traces of segmentation and apparently a chitinous cuticle (Plate LXXI, fig. 7 *i*).

An older form with fifty-seven bristled segments was procured at St. Andrews in May and it probably represents the young of the previous year, as also does a somewhat larger form brought from deep water the same month. The lobes of the feet in these are proportionally more elongate than in the adult.

Similar young in tubes are common in deep water and they show long tips to the heterogomph bristles.

At Lochmaddy in August an example with sixty-three bristled segments was found, measuring about 1 in. in spirit. Such may have been hatched very early the same year, but this diagnosis is uncertain, for it is possible that it may have belonged to the previous year.

[1] 'Journ. Coll. Sci. Univ. Tokyo,' vol. xvii, art. ii, 1903; also 'Ann. Nat. Hist.,' ser. 7, vol. xv, p. 35. I am indebted to the author for excellent examples of this form.

Busch[1] (1851) figures a larval Nereid with four eyes and six bristled segments, the posterior end having two short caudal cirri, but its identity with this species is problematical.

In the British Museum this widely distributed species has various titles, probably in some cases from confusing preparations and their bottles.

Baster[2] (1759) gives a fairly good figure of this species, with an enlarged drawing of a foot. He considered the marine Nereids as the analogues of the Centipedes on land.

So far as observed the *Nereis fimbriata* of O. F. Müller, Dr. Johnston, and others is only a deep-water variety, very common on the eastern shores, with somewhat longer cirri and more pointed lobes to the feet. O. F. Müller noticed that this form, his *N. verrucosa*, readily reproduced lost parts.

This is probably the species figured by Montagu (MS. Drawings, Linn. Soc., Plate VIII, fig. 2, 1808) as *Nereis pulsatoria*.

Malmgren[3] showed that *Heteronereis grandifolia*, H. Rathke, was the male epitokous condition of *N. pelagica*.

Ehlers (1868) points out that *Lycoris margaritacea* and *Nereis fimbriata* of Dr. Johnston belong to this species, and so with the *Nereis fulgens* of Dalyell. It is doubtful if this author's *Nereis procera* from the Gulf of Georgia is other than a variety of *N. pelagica*, and so with the same form mentioned by Langerhans from Madeira.

Marenzeller[4] (1889) distinguishes *Nereis zonata*, Malmgren, from this species by the colour, by the fact that only a single tooth occurs in Group I of the paragnathi, seldom two, a single tooth in V, whilst in Group VI there are from five to ten, generally seven, whereas only three or four are present in *N. pelagica*. The bristles likewise differ, and whilst *N. pelagica* is rare in Spitzbergen, *N. zonata* is common.

Cunningham[5] (1888) states: "In *N. pelagica* I find (neural) canals placed in the positions ascribed by McIntosh to those of *N. virens*. There is one dorsal median in the fibrous partition between the canals, a pair corresponding to the typical pair of *Sigalion*, and another pair consisting of one on the external border of each cord."

Biedemann (1891) gives a minute account of the nervous system of this species, and he shows large neural canals (giant fibres).

2. Nereis cultrifera, *Grube*, 1840. Plate LII, fig. 3; Plate LX, figs. 7 and 7 *a*—head; Plate LXXI, figs. 8–8 *d*—feet; Plate LXXII, figs. 1–1 *c*—epitokous feet; Plate LXXXI, figs. 1 and 1 *a*—bristles.

Specific Characters.—A larger and less rounded species than the foregoing. Head with a rectangular posterior part on which are the four large eyes often obscured by the mottled pigment. The anterior part is furrowed and bears two short tapering tentacles.

[1] 'Beobach. Anat. Entwickel. Wirb. Seeth.,' Taf. ix, figs. 11 and 12, 1851.

[2] 'Opuscula Subseciva,' Tom. ii, Lib. ii, Taf. vi, fig. 6.

[3] 'Nord. Hafs-Annul.,' p. 106, 1865.

[4] 'Arch. f. Naturges.,' lv, p. 128.

[5] Loc. cit., p. 270.

Palpi massive, the distal process encircled by a band of brown and with a pale tip, fused to the anterior region of the prostomium almost to the bases of the tentacles. The dorsal tentacular cirri of the second pair are nearly twice as long as those of the anterior pair. Peristomial segment narrower than in *Nereis pelagica*.

Body 6—12 ins., greenish anteriorly, pale brownish in the middle and again greenish posteriorly, with the sinuous red or purplish blood-vessel branching in each segment, and an orange or golden iridescent hue exists on each side of the vessel, whilst the feet are greenish. Posterior part of each segment with a greenish-black bar, and another exists anteriorly. Whitish grains on every segment after the anterior fourth, and a distinct white patch at the base of the caudal cirri. Ventral surface pale and iridescent.

The proboscis in extrusion has dark brown horny jaws with about five teeth. Dorsally behind these are a single median tooth (I) and two lateral crescents (II) of paragnathi, which are less developed than in *Nereis pelagica*. Ventrally this maxillary region has two lappet-shaped patches or crescents of similar small teeth (IV), the convexity being inward. In the middle line between the foregoing is a group (III) of about six small teeth. In the basal division of the organ ventrally is a belt formed of a conspicuous double row of isolated paragnathi (VII and VIII), the size in each row being nearly equal, though, if irregularity occurs, the smaller are in the posterior row. Dorsally the basal region has a transversely elongated tooth of a bluntly conical shape on an elevation on each side (VI), whilst between and rather behind them are a median and two lateral teeth (V).

First foot has a greater development of the dorsal and ventral lobes than in *N. pelagica*, whilst the setigerous lobe is less. Feet generally with longer and more pointed lobes than in *N. pelagica*, but the dorsal cirrus is rather shorter. Bristles of two kinds, viz., those with long, slender, tapering tips (homogomph), and secondly those with short tips (heterogomph), which have a more decided curve at the base, and the spinous region is shorter. The striæ are less regular than in *N. pelagica*. Toward the tip of the tail the dorsal region of the foot becomes much enlarged. Claparède[1] observes that this and the second foot have no spines, a feature formerly mentioned by Rathke[2] in connection with *Nereis pulsatoria*. Whilst no spine occurs in the first foot of the British examples examined, a spine is present in the second foot.

Epitokous Form.—Eyes large and convex, almost confluent on each side, and with lenses. Anterior (nereid) region has nineteen feet; the succeeding region has about seventy-two feet furnished with swimming bristles and lamellæ. Dorsal and ventral cirri of the first seven feet as in *N. pelagica*, only the enlargement is slight in the ventral, and it ceases sooner. In the fully developed pelagic foot the dorsal cirrus in the male has seven or eight papillæ on its lower border. An accessory fan-shaped lamella at the base of the lobe beneath the superior setigerous process. Ventral lobe with a spur at its base. An accessory small lamella in addition to the two at the ventral cirrus.

[1] 'Annél. Nap.,' p. 163.
[2] 'De Bopyro et Nereide.'

Synonyms.

1761. *Nereis cerulœa,* Linnæus. Fauna Suec., ed. 2, p. 508.
1787. „ „ Pennant. Brit. Zool., iv, p. 47.
1791. „ *cœrulea,* Linnæus. Syst. Nat. (Gmelin), ed. 13, i, pt. 6, p. 3117.
1806. „ *cerulœa,* Turton's Linnæus, iv, p. 88.
1807. „ *cœrulea,* idem. Brit. Fauna, p. 135.
1812. „ *cerulœa,* Pennant. Brit. Zool., ed. 4, p. 93.
1817. „ *cœrulea,* Stewart. Elements, i, p. 390.
1826. *Lycoris lobulata,* Risso. Hist. Nat. Europ., iv, p. 416.
1840. *Nereis cultrifera,* Grube. Actin. Echinod. u. Würm., p. 74, f. 6.
1849. „ *margaritacea* (Leach). M. Edw., Cuvier's Règne Anim., pl. xii, f. 1.
1851. „ *cultrifera,* Grube. Fam. Annel., pp. 49 and 126.
„ „ *lobata,* idem. Ibid., pp. 50 and 127.
1862. „ *Beaucoudrayi,* Keferstein. Zeitschr. f. wiss. Zool., Bd. xii, p. 94, Taf. viii, f. 1—6, 12.
1864. „ *cultrifera,* Grube. Insel Lussin, p. 81.
1865. „ *cœrulea,* Johnston. Cat. Worms Brit. Mus., pp. 154 (excl. syn.) and 341.
„ *Heteronereis lobulata,* idem. Ibid., p. 161 (excl. syn.).
„ „ *fulva* (Sav.), De Quatrefages. Annel., i, p. 507.
„ „ *ventilabrum,* idem. Ibid., p. 517.
„ „ *cultrifera,* idem. Ibid., p. 527.
„ „ *bilineata,* idem. Ibid., p. 535 (excl. syn. Johnst.).
„ „ *incerta,* idem. Ibid., pl. vii, f. 3—10. Explic. des Pl., p. 12.
„ „ *Beaucoudrayi,* idem. Ibid., p. 533.
„ „ *viridis,* idem. Ibid., p. 539.
1867. *Lipephile margaritacea* (M. Edw.), Malmgren. Annul. Polych., p. 50.
„ *Hedyle lobulata,* idem. Ibid., p. 58, *forma epitoca.*
1868. *Nereis cultrifera,* Ehlers. Börstenw., p. 461, Taf. xviii, f. 31—37, Taf. xix, Taf. xx, f. 1—3, Taf. xxi, f. 31—36.
1870. „ (*Lipephile*) *cultrifera,* Claparède. Annél. Nap. Suppl., p. 75, pl. vii, f. 1.
1874. „ *cultrifera,* McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 199.
„ „ *cœrulea,* Malm. Göteb. vet. o. vitt. Handl., xiv, p. 83.
1875. „ *cultrifera,* McIntosh. Invert. and Fishes St. Andrews, p. 122.
„ „ „ Marion and Bobretzky. Ann. Sc. Nat., 6e sér., t. ii, p. 16.
1879. *Perinereis cultrifera,* Langerhans. Zeitschr. f. wiss. Zool., xxxiii, p. 289.
1881. „ „ idem. Canar. Annel. in Nova Acta Leop., p. 110.
1883. *Nereis* „ Levinsen. Vidensk. Meddel. Foren. Kjöbenh., p. 236.
1885. „ „ Carus. Fauna Medit., p. 218.
1886–7. „ „ Meyer. Mitth. Zool. Stat. Neap., vii, p. 740, pl. xxvii, f. 1—8 (young).
1887. „ „ (development), Salensky. Arch. Biol. Belg., vi, p. 589.
1889. „ „ Horst. Contrib. from Leyden Mus., t. xi, p. 162.
1890. *Lipephile* „ Giard. Bull. Sc. Fr. et Belg., t. xxii, p. 77.
„ „ „ Malaquin. Annél. Boulon, p. 31.
1892. *Nereis* „ (eye), Andrews. Journ. Morph., p. 179.
1895. *Lipephile* „ De St. Joseph. Ann. Sc. Nat., 7e sér., t. xx, p. 215.
1896. *Nereis margaritacea,* Roule. Camp. 'Caudan,' p. 449.
1898. *Perinereis cultrifera,* De St. Joseph. Ann. Sc. Nat., 8e sér., t. v, p. 317, pl. xvii, f. 113, 114, and pl. xviii, f. 115, 116.

1902. *Nereis cultrifera,* McIntosh. Ann. Nat. Hist., ser. 7, vol. x, p. 256.
1904. „ „ Allen. Journ. M. B. A., N.S., vol. vii, p. 224.
1905. „ „ Graeffe. Arbeit. Zool. Stat. Triest, xv, p. 322.
1906. *Lipephile* „ (movements), Bohn. Ann. Sc. Nat., 9e sér., t. iii, p. 80.
„ *Perinereis* „ De St. Joseph. Ann. Sc. Nat., 9e sér., t. iii, p. 221.
„ *Nereis* „ Eisig. Fauna u. Fl. Neap., xxviii, p. 207.
1909. „ „ Elwes. Journ. M. B. A., N.S., vol. viii, p. 352.

Heteronereid Form.

1820. *Lycoris lobulata,* Savigny. Syst. de Annel., p. 30.
1825. *Nereis* „ De Blainville. Dict. Sc. Nat., xxxiv, p. 430.
1828. „ „ idem. Ibid., lvii, p. 468.
1833. „ „ Audouin and Edwards. Ann. Sc. Nat., t. xxix, p. 123, pl. xiii, f. 7, 8.
„ „ „ idem. Ibid., p. 124.
1834. „ „ idem. Annél. du lit. France, ii, p. 191, pl, ivA, f. 7 and 8.
1837. *Lycoris* „ Rathke. Beitr. z. Fauna der Krym. in Mém. l'Acad. St. Pétersb., t. iii, p. 415, Taf. vii, f. 2, 9—15.
1851. *Nereis* „ Grube. Fam. Annel., pp. 50 and 127.
1865. *Heteronereis lobulata,* Johnston. Cat. Worms Brit. Mus., pp. 161 and 341 (*partim*).
„ *Nereilepas lobulatus,* De Quatrefages. Annel., i, p. 560.
„ *Hedyle lobulata,* Malmgren. Nord. Hafs-Annul., p. 182.
1867. „ „ idem. Annul. Polych., p. 58.
1868. „ „ Ehlers. Börstenw., ut antea.
1870. *Nereis* (*Lipephile*) *cultrifera,* Claparède. Suppl. Annél. Nap., p. 75, pl. vii, f. 1.
1898. *Perinereis cultrifera,* De St. Joseph. Ann. Sc. Nat., 8e sér., tome v, p. 318.

Habitat.—Between tide-marks on both eastern and western shores of Britain (from Shetland to the Channel Islands), under stones, and in tunnels in masses of peat. Extends also to both shores of Ireland, especially the western, as at Dingle Bay and Valentia Harbour (J. G. Jeffreys).

Ranges to the Mediterranean, shores of France (De St. Joseph), Canaries (Langerhans), Black Sea (Bobretzky).

Head (Plate LX, fig. 7) with a rectangular posterior region on which are the four large eyes, the posterior pair often rendered obscure by the dark mottled pigment. The anterior eyes are wider apart. The front part of the head is bluntly conical, the truncated anterior region bearing two short tapering tentacles, which are somewhat less flattened than in *N. pelagica*. Moreover, a marked median furrow, often boldly indicated by the arrangement of pigment, passes along the centre of this region, leaving two lateral fillets. The palpi are massive, the distal papillæ encircled by a band of brown at the base and with a pale tip. The inner border of each palpus is fused to the conical anterior region of the prostomium almost to the bases of the anterior tentacles, a diagnostic feature in comparing with *N. pelagica*. The two pairs of tentacular cirri are similarly situated to those of the latter species, the dorsal being the longer in each case. The dorsal of the second pair is nearly twice as long as that of the anterior pair.

Body proportionally more elongate than in *N. pelagica*, some nearly reaching a foot in length, very little tapered anteriorly, but much more so posteriorly, where it terminates in two long slender cirri. The peristomial segment is broader than the succeeding,

but considerably narrower than the corresponding segment in *N. pelagica*. The body is greenish anteriorly, pale brownish in the middle and again greenish posteriorly. A deep purplish blue line extends along the dorsum, with the sinuous dark red or purplish blood-vessel branching in each segment and with long twigs directed backward. An orange or golden iridescent hue exists on each side of the vessel, whilst the bases of the feet and these organs themselves are generally greenish. The posterior part of each segment has a greenish-black bar extending quite across the junction, and in addition another on each side anteriorly—formed, as it were, of a single bar separated by the dorsal blood-vessel. These markings become indistinct when the brownish median hue takes the place of the anterior greenish. Moreover, in the latter region an oblique (longitudinal) whitish streak occurs on each side in every segment, and whitish grains on the segments behind the anterior fourth. A distinct white patch is on the tail at the base of the cirri. The ventral surface is pale and iridescent. The inferior edge of the foot is the most vascular, whilst a series of bright red transverse vessels passes from the posterior border of each towards the interspace. The ventral vessels are of a much brighter red than the dorsal.

After preservation it is somewhat duskier than *Nereis pelagica*, and the head and anterior segments have small whitish specks. A pale central patch also occurs at the anterior border of several of these.

Proboscis.—Dorsally (Plate LX, fig. 7) the strongly curved jaws present about five teeth, and they vary in position, in some the left and in others the right passing above the other. In extrusion the basal or proximal division of the organ has an elevation on each side with a transversely elongated tooth of a bluntly conical shape, whilst between and slightly behind are a median and two lateral teeth, the former being slightly in front. In the maxillary (distal) division of the proboscis a single median tooth occupies the central region dorsally, whilst two crescents occur laterally, one on each side. These are more feebly developed than in *N. pelagica*. Ventrally (Plate LX, fig. 7 *a*) two lappet-shaped patches or crescents of similar small teeth occur in a corresponding position, the convexity being inward. In the middle line between the foregoing is a group of about six small teeth. In the basal division of the organ ventrally is a belt formed of a double row of well-marked isolated teeth, the size of these in the rows being nearly equal, though if irregularity occurs in this respect, the smaller teeth are found in the posterior row in extrusion. There is thus a great difference between the single row of large teeth and the "dusting" of smaller prickles as in *Nereis pelagica*. Some of the large examples have numerous calcareous deposits on the proboscis.

Specimens frequenting tunnels in peat had stalks of Algæ in the hind-gut, and in others from the Channel Islands the fæcal masses were enveloped in mucus, and consisted of delicately branched pale Algæ with muddy *débris*. The central parts of the filaments of the Algæ had been acted on by the gut, leaving only the cellulose exterior.

The perivisceral or cœlomic corpuscles are translucent bodies, spindle-shaped or elliptical in outline, and varying in size (December). Free nuclei lay near or on them. The larger elliptical corpuscles show minute granules, and free granules (minute nuclei?) floated in the fluid. About a week later during very cold weather a female which had been isolated showed its perivisceral fluid so loaded with small rounded corpuscles as to

be slightly opaque to the naked eye. In the fluid were also many of the larger cells with coarsely granular contents. A few of the elongated cœlomic corpuscles were still visible. There were also a few ova. Such a condition raises the question as to the changes in the fluid after confinement. In a dying example the fluid abounded with disintegrating cells and granules, but the perivisceral corpuscles proper were few. There were also groups of circular pellucid cells, and ova with nuclei and nucleoli, surrounded by the smaller cells. Some of the bodies showed a punctate zone, which may have been connected with Gregarinæ, having a thickened anterior end. It is a large broad form. The fatty globules in the eggs of the annelid are remarkably large, whereas the granules in the parasitic (?) bodies are small. De St. Joseph[1] found gregarines in other forms, such as *N. Dumerilii*.

The first foot (Plate LXXI, fig. 8) is distinguished from that of *N. pelagica* by the greater development of the upper and lower lobes and the rudimentary condition of the setigerous lobe. The dorsal edge of the foot is more prominent, but the cirrus is somewhat shorter. The dorsal lobe is larger and more pointed, and the same may be said of the inferior lobe, which is, however, less acute. The setigerous or median lobe offers a marked contrast to the corresponding part in *N. pelagica*, since it is much less prominent. The ends of the upper long-tipped homogomph bristles are shorter, whilst those of the lower series are somewhat longer. The ventral cirrus is shorter. Both species have black spines.

At the tenth foot (Plate LXXI, fig. 8 *a*) the dorsal cirrus is shorter, the upper lobe more triangular in lateral view, and the distance between the dorsal edge and the first bristle-bundle greater than in *N. pelagica*. Moreover, a small but distinct superior setigerous lobe is present—none being visible in *N. pelagica*. The inferior setigerous lobe is less acute than in the latter, and the ventral cirrus is less in proportion to the bulk of the foot, and it extends outward only to the middle of the great ventral lobe. The bristles of the dorsal process have long, slender, serrated tips, as in *N. pelagica*, but the transverse striæ of their shafts are bolder and less regular (Plate LXXXI, fig. 1 *a*). The bristles with the shorter tips in the inferior division (Plate LXXXI, fig. 1), while somewhat similar to those of *N. pelagica*, have a more decided curve at the base of the terminal piece, and the spinous region, like the whole structure, is shorter. The transverse lines or cameræ in the centre of the shaft are less regular than in *N. pelagica*. The tip in both shows a slight differentiation, indicated by a line within the margin.

In the thirty-seventh foot (Plate LXXI, fig. 8 *b*) the two upper lobes are proportionally longer than in *N. pelagica*, and they have a wider space between them, since a minute spinigerous process separates them. The dorsal cirrus is considerably shorter and smaller. The inferior setigerous lobe is somewhat less, while the ventral lobe is more deeply cleft superiorly, and thus appears to be longer. The ventral cirrus, like the dorsal, is both shorter and smaller than in *N. pelagica*.

At the fifty-seventh foot the enlargement of the dorsal region is even more marked, and the cirrus is carried further outward. In shape, however, the dorsal lobe and all the others conform to the condition just described.

Towards the tip of the tail (Plate LXXI, fig. 8 *c*) the enlargement of the dorsal region has altered the shape of the foot, since the dorsal lobe in lateral view occupies

[1] 'Ann. Sc. Nat.,' 7e sér., t. xx, p. 215.

half the depth. Externally it terminates in an acute tip, and the slightly elongated dorsal cirrus is carried so far outward on the ridge of the flattened lamella that it extends considerably beyond the dorsal lobe. The upper setigerous lobe is now indistinguishable in the sulcus between this and the next lobe, the reduction in the size of which makes the disproportion between it and the dorsal lobe very conspicuous when contrasted with the condition in the fifty-seventh foot. The inferior setigerous lobe is reduced in size, and the ventral lobe is so small that it projects little beyond the tip of the former. The ventral cirrus is considerably smaller, and its base less prominent, while its tip goes little further than the base of the ventral lobe.

This species is often infested in Guernsey and Herm by the crustacean parasite *Nereicola ovata*, Keferstein,[1] which generally occurs towards the posterior end of the annelid, the largest example of which had about fifteen specimens, most of them, however, being small. The usual number is four or five. They adhere firmly either to the groove between two feet or to the sides of the feet, but they do not seem to incommode the worms, and it may be supposed that the *Nereis*, if so inclined, can at any time remove them. It is, however, by no means an active species.

The male *Nereicola* (Fig. 66) is small and has a somewhat ovate carapace, which, however, diminishes posteriorly. It has in front minute chitinous processes like hairs, and a pair of antennules composed of four segments uniformly diminished from base to apex. The edges of the last three, under pressure, have minute projections from which the setæ spring. The tip of the organ has several setæ which are longer than itself. Behind these is a more cylindrical pair of antennæ of the same number of segments, the tip having five long setæ, one of which surpasses the others in length. The mouth has two pairs of appendages, probably representing mandibles and maxillæ, the posterior having its terminal process furnished with a single strong claw. Three appendages occur on the ventral surface of the carapace behind the foregoing, the first two being biramous limbs attached to a basal process, the third a rudimentary one in the form of a simple process. The testes form a pair of symmetrical organs posteriorly, the narrowed region behind being terminated by two styles.

The young female (Fig. 68) has an ovoid outline, with a blunt anterior and a narrower posterior region, and both antennæ and caudal styles are visible from the dorsal surface. In the fully developed condition (Fig. 67) the thoracic region is greatly enlarged, so that dorsally the outline is rounded ovate, with a narrower region in front, and it is only in a lateral (Fig. 69) or ventral view that the snout and tail are fully seen. The antennæ are similar to those of the male, as also are the appendages of the mouth and the carapace posteriorly. The ovisacs are attached by slender pedicles to slight prominences on each side, and form cylindrical pouches filled with a vast number of ova. The same form was found by Grube at St. Vaast-la-Hougue,[2] and by the author[3] in the Channel Islands.

The segmental organ of the annelid has a trumpet with somewhat short fimbriæ or lobes and long cilia (Goodrich).

[1] 'Zeitschr. f. wiss. Zool.,' Bd. xii, p. 461, Taf. xlii, f. 1—4, 1860.

[2] Grube termed it *Nereidicola ovata* in his 'Notes on the Fauna of St. Vaast-la-Hougue,' and he gave two good figures.

[3] 'Quart. Journ. Micros. Sci.,' vol. 10, N.S., p. 39, pl. v.

Reproduction.—An almost ripe male was observed on July 1st, and as no alteration of the feet was visible the epitokous condition would appear to be suddenly developed.

In a male towards the end of November the reproductive elements form large compound cells with many nuclei, and they vary much in size. Most are more or less

Fig. 66.

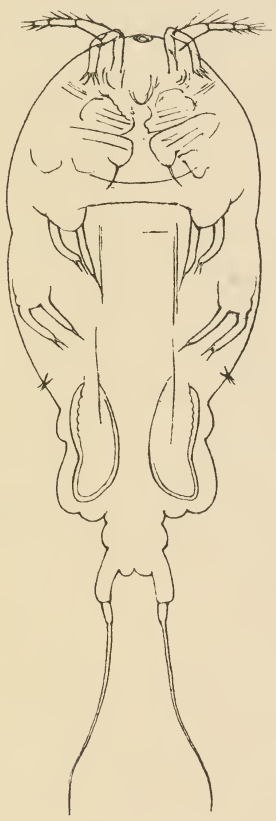


Fig. 67.

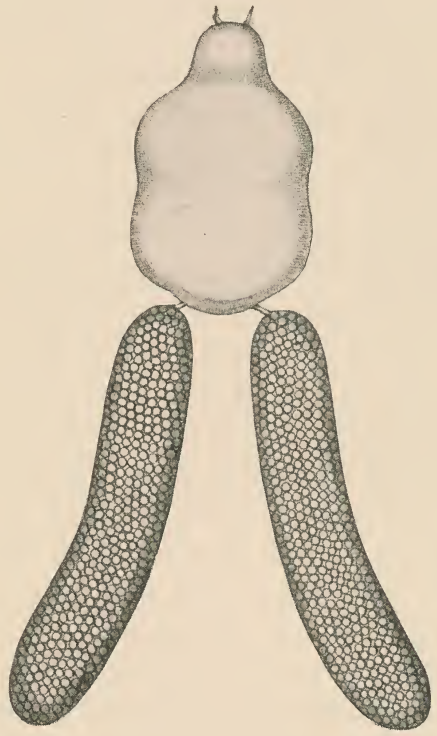


Fig. 68.

Fig. 69.

Fig. 66.—*Nereicola ovata,* male, as a transparent object. Fig. 67.—Female from the dorsum. Fig. 68.—Young female from the dorsum. Fig. 69.—The adult female in lateral view. All magnified.

rounded. Besides these are translucent spheres and groups of smaller cells with nuclei—apparently having escaped by rupture from the larger corpuscles. They measure about ·00021 in., the smallest being one sixth of that size. There are also elongated transparent bodies. When breaking up, the smaller corpuscles show coarse granules, and probably these pertain to the wall of the alimentary canal.

On the 18th of January the males, which are smaller than the females, have the cœlom laden with sperms, which are not very active, though they exhibit slight movements. The "head" has a knob followed by a somewhat ovoid region terminating in the filament posteriorly. The under surface of the worm is pale anteriorly, reddish from the blood-vessels posteriorly.

On 6th December some of the females are laden with ova, which when extruded in mass have a dull or faintly greenish aspect. The ova are surrounded by a coating of yellowish cells filled with refracting granules, a coarser series also filling the ova, which present a large nucleus and nucleolus. On the 18th of January the ova are still numerous in the perivisceral cavity, and the nucleus and nucleolus can be made out under a lens.

The only *Heteronereis* pertaining to this species comes from Ireland, the exact locality not being indicated. The specimen, a male, is between two and three inches (two inches in spirit). The eyes are large and convex, the anterior almost touching the posterior on each side. They are chiefly developed laterally, and have a small lens in the centre of each. The pigment of the dorsum of the body seems to have been specially developed in bands and touches across the middle of each segment. The anterior region has nineteen feet—distinguished as usual by their greater thickness. The succeeding region has seventy-two feet, furnished with the swimming bristles and lamellæ. The last, however, are very small. The vent is everted and richly papillose, and two long cirri project posteriorly. The segments of the anterior region are wider, those of the posterior narrow, but the sulci between the segments are in both transverse. The paragnathi of the proboscis do not appear to differ from the typical form. The first foot has its dorsal cirrus enlarged, as in *N. pelagica*, and a slight increase has also occurred in the ventral. This enlargement continues to the seventh foot as regards the dorsal cirrus, but it ceases sooner in the ventral. The feet remain of the normal structure till the seventeenth, in which the dorsal cirrus has a papilla at its ventral border near the tip, this marking off the filiform termination, and the ventral cirrus of the same foot presents a swelling near its tip. The dorsal cirri of the eighteenth and nineteenth segments show one or two additional papillæ, and the terminal region is often bent at an angle. The tips of the ventral cirri of the eighteenth and nineteenth are as in the seventeenth, but the nineteenth (Plate LXXI, fig. 8 *d*) has a small process (lamella) arising on the inner side of the base of the cirrus, and a more minute one to its exterior. A small lamella also appears at the lower edge of the tip of the inferior setigerous process. An opaque granular mass (gland ?) occurs at the base of the dorsal cirrus, and the tips of the five lobes of the foot and the base of the ventral cirrus are all similarly opaque. The bristles of this foot retain the normal outline.

The heteronereid condition is more distinctly pronounced in the next (twentieth) foot (Plate LXXII, fig. 1), which presents a small vertical lamella internal to the base of the dorsal cirrus. The latter has four papillæ and traces of two others below the filiform tip. The inferior setigerous process has a considerable fan-shaped lamella with a pit in the middle at the tip, as if from the coalescence of two folds. The lamellæ at the base of the ventral cirrus have increased, and the cirrus comes from the edge. The margins of the second lobe and of the ventral also show traces of increase. A few bristles of the atokous type remain in the superior setigerous lobe, but the ends of the shafts and

the broad tips of the swimming bristles project in a dense mass from the foot, showing that they are rapidly developing. None are yet seen in the inferior setigerous process.

The pelagic foot is fully developed behind the foregoing, and at the thirty-seventh foot (Plate LXXII, fig. 1 *a*) the parts perhaps attain their maximum. A large fan-like lamella is internal to the dorsal cirrus, which shows seven or eight papillæ on its lower border. A small lamella projects at its base externally. The dorsal lamella is long, thin, and tongue-shaped. The superior setigerous process has a lamellar fan of a semi-circular outline in front of the dense group of swimming bristles. The next lobe of the foot forms a large and lanceolate lamella, with an accompanying fan-shaped flap depending from its base. A great fan-like lamella extends above, below, and beyond the swimming bristles of the inferior setigerous process. The ventral lobe has a marked spur at its base superiorly. A considerable fan-shaped lamella occupies the ventral (internal) region of the ventral cirrus, whilst a narrow lamella externally and an accessory smaller one are near the base on the same side. The cirrus projects from the edge of the lamella, an opaque granular band connecting it with the body.

The condition at the fifty-seventh foot of the same epitokous male is shown in Plate LXXII, fig. 1 *b*, and near the tip of the tail in fig. 1 *c*, the former presenting in proportion to its size very large foliaceous lamellæ, the latter showing considerable diminution in all the processes.

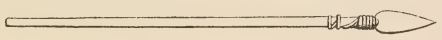


Fig. 70.—Long spear-like instrument used by the fishermen of Guernsey in digging for *Nereis cultrifera*.[1]

These annelids form a favourite bait at various parts of the coast, especially in the south. Thus the fishermen of St. Peter Port, Guernsey, dig for them with pointed instruments resembling spears (Fig. 70) and keep them in vessels amongst a little sand and seaweed. They are often used for capturing whiting, which again are cut into portions for the capture of conger. They form a very successful bait, and in these rich waters various species of wrasse, besides bream, whiting-pout, various species of blenny, and other fishes are readily captured.

The *Nereis megodon* of De Quatrefages (1865) has certain resemblances to this species, but it is difficult, with the materials at hand, to ascertain its precise relationships.

Ehlers (1868) gives a detailed account of the anatomy of this species as the type of the family, and rectifies the synonymy.

Claparède (1868) found this Nereid common at Naples, where it is known by the fishermen as *esca*. He was sure it was known to Delle Chiaje, but it is difficult to make certain either in regard to figures or description. Possibly it may be his *Nereis Rauzani*. He is doubtful whether Ehlers' view that the *N. margaritacea* of M. Edwards is this form is correct, basing his opinion on the fact that while the figures in the 'Règne Animal' closely resemble it, these were subsequently referred by De Quatrefages to *N. incerta*, which differs in paragnathi, and whereas the Neapolitan examples had only sixty-five to seventy segments those of De Quatrefages had 170. Subsequently (1870) he gave special attention to the heteronereid form, showing that the change is accompanied by the absorption of the

[1] For the use of this block the author is indebted to Messrs. Taylor and Francis.

peritoneal pigment in the middle and posterior regions, thus giving a pinkish hue to the animal from its vascularity. In the female the greenish coloration exists in the first twenty segments, the abdominal region being pale, variegated with black. He thinks the male heteronereids are smaller. The spermatozoa are similar to those of *N. Dumerilii*. The eggs are colourless, and 0·15 mm. in diameter. He found the metamorphosis in progress in specimens about the end of March at Naples, but they were rare. The sexual elements are developed in individuals of large size—apparently before metamorphosis.

Claparède (1870) states that the following arrangement of the bristles is constant:—

Superior division		Homogomph with long tips.
Ventral division	Superior	Ditto, falcate heterogomph.
	Inferior	Homogomph with long tips, falcate heterogomph.

Ehlers again avers that there are no falcate bristles in the inferior groups of the ventral division, but there seems to be a difference of opinion as to what is a falcate bristle. So far as general description goes that of Claparède holds.

Grube (1869) gave a description and figure of *Nereidicola bipartia* which he had found parasitic on the feet of this species at St. Vaast-la-Hougue. This is probably the same as Keferstein's *Nereicola ovata*.

Ed. Meyer (1886—7) refers to a young form of this species having six bristled segments, and especially to the development of the segmental organs and other structural features.

In the collection of the British Museum this form is contained in bottles under the names, *e.g.*, *Nereis cerulæa*, *Nereis brevimana*, and *Nereis pelagica*.

De St. Joseph[1] found considerable variation in the groups of paragnathi. Those least variable were the two cultriform paragnathi on the dorsum of the basal segment, and the double row on the ventral surface of the same region.

Benham[2] mentions that the species is known by the name of the "Red Cat" in the south.

Schepotieff gives in this form a careful account of the bristle-sacs, with the developing bristles.[3]

Claparède[4] states that the foot-glands and the dorsal muciparous glands increase in volume at the period of sexual maturity. Langerhans met with an epitokous female at Madeira.

On the shores near Cherbourg, M. Fauvel found the heteronereid in April and May.

De St. Joseph gives a careful account of both sexes in the heteronereid condition. In the female the large eyes are almost coalescent, the head and four anterior segments being dull green. In the first six segments following the buccal, the cylindrical dorsal cirrus is abruptly narrowed towards its extremity, and a similar condition occurs in the shorter ventral cirrus. The heteronereid condition of the feet commences at the twenty-second bristled segment.

Lo Bianco[5] found *N. cultrifera* mature and depositing ova at Naples from May to June, the yellowish ova being enveloped in mucus on Algæ dredged at some depth.

[1] 'Ann. Sc. Nat.,' 7e sér., xx, p. 215, 1895.
[2] 'Camb. Nat. Hist.,' ii, p. 316.
[3] 'Zeitschr. f. wiss. Zool.,' Bd. lxxvi, p. 589, Taf. xxvi, and Taf. xxvii, figs. 1—4, 1904.
[4] 'Annel. Nap.,' p. 164, 1868.
[5] 'Mitth. Zool. Stat. Neap.,' xiii, p. 488, 1898.

3. Nereis Schmardæi, *De Quatrefages*, 1865. Plate L, fig. 17; Plate LX, fig. 8—head; Plate LXXII, figs. 2–2 *b*—feet; Plate LXXXI, figs. 2–2 *c*—bristles.

Specific Characters.—Head typical in shape. Eyes large and furnished with lenses, anterior pair oval, posterior circular. Tentacles rather stout and short. Palpi with somewhat slender terminal joints, a ring of pale madder-brown occurring within the tip. Tentacular cirri rather long. A madder-brown patch like a crown occurs in front, with a longitudinal median streak, and behind it a brownish patch with a pale area on each side of the posterior eyes. Body 4—5 ins. long, more definitely tapered anteriorly than usual. Of a pale flesh colour throughout, the anterior third toning off to pale yellow, and dull whitish posteriorly. The palpi, peristomial segment, and a considerable number of the anterior segments are flecked with pale madder-brown touches or specks irregularly scattered over each segment, and, after they decline, whitish touches occur at the segment-junctions in the line of the blood-vessel, and posteriorly a double yellowish-white streak occupies the mid-dorsal region of each segment. About the tenth bristled segment a differentiated region is found near the base of each foot in the form of two or three pale brownish dots, and as the body becomes paler the region is recognized by a pale, transversely elongated area on each side at the base of the foot, and a minute black speck often lies at its inner side. These lateral white patches continue within a short distance of the tip of the tail. *Proboscis* in extrusion has a pair of horny maxillæ with twelve to thirteen denticulations. Dorsally the maxillary segment has a row of paragnathi (II) at the bases of the jaws. Ventrally at the base of each maxilla are a crescent and a spur of larger paragnathi (IV), with a group of smaller at the posterior angle between crescent and spur. Dorsally in front of the palpi is on each side a group of small paragnathi (VI) in two rows. The basal division has ventrally a long row of paragnathi in lozenges (VII and VIII). As a rule a larger one is in front near the angle of the lozenge and a row of smaller behind. The first foot is short, a brief space intervening between the body and the dorsal cirrus, the tip of which scarcely reaches that of the dorsal lobe. The latter forms a conical blunt cone. Setigerous lobe beneath is obscured by a conical lobe behind it. Ventral lobe large and tongue-shaped. The chief feature of the anterior feet is the rounded, bulbous nature of the lobes and the short cirri, so that at the tenth foot the parts present a bluntly papillose appearance. The lobes become considerably longer after the thirtieth foot, and at the thirty-fifth the dorsal cirrus reaches the end of the lanceolate dorsal lobe. The superior setigerous process has an elongated anterior papilla soldered to it inferiorly. The lamella beneath is shorter and broader than the dorsal. The inferior setigerous lobe is irregularly conical and bifid, a flap being in front and the shorter lip behind. Ventral lamella short and lanceolate. Ventral cirrus small, projecting from an elevated base. Bristles of the dorsal setigerous lobe homogomph, as in the typical Nereids. Those of the inferior lobe at its upper edge are similar, though the tips are shorter, but those toward the ventral border have short tips (heterogomph).

Epitokous Form.—The nearly ripe Heteronereid distended with large eggs presents indications of change in the thirty-second foot in the form of a rudimentary lamella

behind the inferior setigerous process. In full development (*e.g.*, the sixty-fifth foot) a dorsal fan-shaped lamella, a large lamella of similar shape behind the inferior setigerous lobe, and a larger and a smaller lamella at the ventral cirrus characterize the foot. The dorsal, middle, and ventral lobes of the foot are flattened and elongated, and swimming bristles occur in both divisions.

Synonyms.

1865. *Heteronereis Schmardæi,* De Quatrefages. Annel., i, p. 569, pl. vii, f. 11, and pl. ix, f. 7.
1867. *Praxithea irrorata,* Malmgren. Annul. Polych., p. 51 (167), Taf. iv, f. 24.
1868. *Nereis rubicunda,* Ehlers. Borstenw., ii, p. 529, Taf. xxi, f. 5—9.
„ *Heteronereis Schmardæi,* Grube. Mitth. über St. Vaast-la-Hougue (and Jahresb.), p. 126.
1870. „ „ idem. Jahresb. der Schles. Gesells. für 1869, p. 52 (*fide* Auct.).
„ „ „ idem. Mitth. über St. Malo u. Roscoff (ibid. Jahresb.), 1869—72 p. 91.
„ „ „ idem. Arch. f. Naturges., Bd. xxxvi, p. 312.
1874. *Praxilla irrorata,* Malm. Göteb. vet. o. vitt. Handl., xiv, p. 84.
1879. *Heteronereis Schmardæi,* Tauber. Annul. Danic., p. 98.
1883. *Nereis irrorata,* Levinsen. Vidensk. Meddel. Foren. Kjöben., p. 235.
1885. „ *rubicunda,* Carus. Fauna Medit., p. 220.
1888. *Praxithea irrorata,* De St. Joseph. Ann. Sc. Nat., 7e sér., t. v, p. 263, pl. xi, f. 131.
1895. „ „ idem. Ibid., 7e sér., t. xx, p. 215, pl. xii, f. 33–36, pl. xiii, f. 37—39.
1898. *Nereis* „ idem. Ibid., 8e sér., t. v, p. 299, pl. xv, f. 82.
1902. „ „ McIntosh. Ann. Nat. Hist., ser. 7, vol. x, p. 256.
1904. „ „ Allen. Journ. M. B. A., N.S., vol. vii, p. 224.
1906. *Praxithea* „ Bohn. Ann. Sc. Nat., 9e sér., t. iii, p. 83.
„ *Nereis* „ De St. Joseph. Ibid., 9e sér., t. iii, p. 219.
1909. „ „ Elwes. Journ. M. B. A., N.S., vol. viii, p. 352.

Epitokous Form.

1864. *Heteronereis signata,* Baird. Journ. Linn. Soc., vol. viii, p. 8, Taf. i, f. 1 (?).
1865. „ „ Johnston. Cat. Worms Brit. Mus., p. 341 (?).

Habitat.—In tubes between tide-marks, St. Peter Port, Guernsey, July, 1868. In similar regions at Plymouth, and small specimens also dredged (Allen).

Apparently chiefly a southern form. It is not uncommon on the shores of France, such as at St. Vaast, Roscoff, and Dinard, amidst the prairies of Zostera. It is also found in Sweden.

Head (Plate LX, fig. 8) has the typical outline, though the palpi have somewhat slender terminal joints, with a ring of madder-brown within the tip. Anterior eyes oval, posterior circular. They are furnished with lenses, and in the fully developed epitokous form De St. Joseph found them almost coalesced. Tentacles comparatively stout and short. Tentacular cirri rather long. A curious madder-brown patch like a crown with a median longitudinal streak occurs in front of the head, and behind it a brownish patch with a pale area on each side of the posterior eyes.

Body 4—5 ins. long (15—18 cm., De St. Joseph), more definitely tapered anteriorly than usual, and posteriorly terminating in two long anal cirri. The anterior third is of a pale flesh-colour toning to pale yellow or dull whitish posteriorly. The peristomial

segment and a considerable number of the anterior segments are flecked with pale madder-brown touches or specks irregularly disposed, and, after they begin to decrease, whitish touches occur on the segment-junctions in the line of the blood-vessel, and posteriorly a double yellowish-white streak occupies the mid-dorsal line of each segment. About the tenth bristled segment a differentiated region, indicated by two or three brownish dots, occurs near the base of each foot, and as the body becomes paler the region is recognized by a pale, transversely elongated area on each side at the base of the foot, often with a minute black speck at its inner side. These lateral white patches continue almost to the tip of the tail. De St. Joseph gives the body a brick-red colour in life.

The *proboscis* in extrusion has a pair of maxillæ with twelve to thirteen denticulations, the apex being slightly twisted. Dorsally the maxillary segment has a row (II) of paragnathi at the base of each maxilla, and in a corresponding position ventrally are a crescent and a spur of longer paragnathi (IV) with a group of smaller ones at the posterior angle between crescent and spur. Dorsally in front of the palpi (basal division) is on each side a group of small paragnathi (VI) in two rows; whilst ventrally a long row (VII and VIII) of paragnathi occurs in lozenges; as a rule, a large one is in front in the angle of the lozenge, and a row of smaller behind—somewhat similar to the condition in *Nereis pelagica*, but with fewer small paragnathi.

The intestine contains *débris* of *Ulva*, diatoms, and *Grammatophora* (De St. Joseph).

The first foot (Plate LXXII, fig. 2) is short, with but a brief space between the body and the dorsal cirrus, which is comparatively short and stout, its tip scarcely reaching that of the dorsal lobe. The latter forms a massive cone blunt at the tip. The setigerous lobe beneath is obscured by a conical lobe behind it, so that in lateral view only the tips of the bristles are observed. The ventral lobe is large and tongue-shaped, the ventral cirrus short and rather stout (in spirit). The bristles of this part all have tapering tips with finely serrated edges. The third foot shows two setigerous processes as in allied forms.

On glancing along the feet anteriorly one feature is conspicuous, viz., the rounded, bulbous nature of the lobes; indeed, this condition gives a distinctive character to the species. Thus at the tenth foot (Plate LXXII, fig. 2 *a*) the lobes in lateral view resemble bluntly rounded processes. Between the dorsal cirrus and the body is a prominent rounded elevation, and the cirrus is subulate, whilst its tip does not reach the outer edge of the lobe. The superior setigerous lobe beneath forms a low convex process, with a dense fan of bristles, the shafts of which are deeply tinted. All have tapering serrated tips (Plate LXXXI, fig. 2). The lobe beneath is a rounded boss, which does not project so far outward as the dorsal. The inferior setigerous process is a blunt cone, with its long bristles in two divisions—an upper and lower, and each with two kinds of bristles as in the typical Nereids. The upper has those with long tapering tips superiorly, then a series beneath with shorter tips (Plate LXXXI, fig. 2 *a*). The inferior has similar bristles at the upper edge, but those toward the ventral border have longer tips than the corresponding series in the upper group (Plate LXXXI, fig. 2 *b*). The ventral lobe recedes inward as a massive rounded boss, and the small ventral cirrus springs from an elevation of its own.

The specimen consisted of an anterior fragment, so that the structure of the feet

could only be examined as far as the thirty-fourth or thirty-fifth. In this region considerable elongation of the lobes has occurred, whilst the depth of the foot from above downward has increased. The dorsal cirrus reaches to the end of the dorsal lobe, which is lanceolate. The superior setigerous lobe has an anterior elongated papilla soldered to it inferiorly. The lamella beneath is shorter and broader than the dorsal. The inferior setigerous process is irregularly conical and bifid, a flap being in front, and the shorter tip behind. The ventral lamella is short and lanceolate. The ventral cirrus is small and projects from an elevated boss. The bristles by-and-by, as at the thirty-second foot, show only the series with the long tapering tips dorsally; whilst ventrally are (1) two upper powerful bristles and a group of those with long tapering tips only a little shorter than the dorsal, followed (2) by a ventral series, all of which, with the exception of the two upper, which have long tapering tips, have falcate tips.

In an epitokous female from St. Vaast, kindly sent by the late Prof. Grube of Breslau, and much distended with nearly ripe eggs, the changes in the feet begin about the thirty-second and thirty-third in the form of a process or rudimentary lamella behind the inferior setigerous lobe. At the thirty-fifth foot a small vertical lamella appears inside the dorsal cirrus, a considerable flap projects behind the inferior setigerous process, and the ventral cirrus has a small outer and a larger internal lamella. The parts increase in complexity until about the sixty-fifth foot (Plate LXXII, fig. 2 *b*); the fan-shaped lamella on the ridge of the foot forms a leaf-like process, the dorsal cirrus extending from its outer border beyond the tip of the dorsal lamella beneath. The latter is a long lanceolate process. A dense group of swimming bristles (Plate LXXXI, fig. 2 *c*) is borne by the superior setigerous lobe with which the lamella below appears to be fused. The inferior setigerous lobe also carries a dense group of swimming bristles and the large foliaceous expansion behind. The spatulate ventral lamella projects from its lower border, and the ventral cirrus has a narrow lamella at its outer and a large fan-shaped lamella on its inner edge.

The whole foot is largely distended by the ripe eggs, which escape on rupture of the thinned integuments. The imperfect preservation of the specimen still further adds to the distortion of the soft tissues of the foot, so that the drawing, like that of De St. Joseph, might be improved.

The segmental organ has its trumpet fringed with more irregular lobes than in *N. cultrifera* (to judge from the figure) and also furnished with long cilia (Goodrich).

In the form of the anterior feet this species shows certain resemblances to *N. Marionii*, Aud. & Edw., but it diverges in the structure of the posterior feet. The specimen from the Channel Islands is an epitokous female, partially developed, the ova being about one-third grown. It has a dark speck on the ridge near the dorsal cirrus for twenty segments, viz., from the eighth or ninth foot backward.

In the British Museum, in a tube labelled "Tube of *Venusia* from the coast of Cornwall," is an example of this Nereid. The tube is composed of coarse sand, stones, and shell-gravel, and has little secretion, so that it is more lax than that of *Thelepus*. Bohn, in his recent paper on the movements of Annelids, considers this tube-dwelling species very sensible to its surroundings, when free rapidly passing from the reptant

to the pelagic condition. From the description of Dr. Baird, moreover, the form he described as *Heteronereis signata* is in all probability the epitokous condition of *N. Schmardæi*, and accordingly it has been entered doubtfully under that species. The specimen could not be found in the British Museum at the period of examination.

The *Nereis Sarsii* of Rathke[1] has certain resemblances to this form, but it is difficult to determine the exact relationships of the northern form.

The grounds on which Malmgren (1867) founded the genus *Praxithea*, though interesting in themselves, do not seem to be sufficient to warrant the separation.

De St. Joseph procured his examples in coriaceous tubes amongst the mud of the Zostera-flats in company with *Cerianthus membranaceus*, Haime. Gravier,[2] again, met with this form in muddy tubes in the Zostera-region at St. Vaast-la-Hougue in August and September, until it became transformed into a *Heteronereis*.

The species is chiefly a southern one.

4. Nereis (Perinereis) Marionii, *Audouin and Edwards*, 1833. Plate LX, fig. 9—head; Plate LXXII, figs. 3–3 *d*—feet; Plate LXXXI, figs. 3 and 3 *a*—bristles.

Specific Characters.—Head greenish mottled with dark pigment, but the posterior border is pale. Eyes normal, brownish, with lenses anteriorly and occasionally posteriorly. Dorsal of the first pair of tentacular cirri longest, cirrophore greenish, ventral short and thick. All cirri somewhat short. Body 3—4 inches long; peristomial segment twice as broad as the next. Dull olive green anteriorly, paler posteriorly; whitish patch in front of each foot, and a little white pigment in the dorsal median line. Lobes of the feet pale. Posteriorly are two short caudal cirri. Proboscis with strong curved jaws having five teeth. Paragnathi feebly developed. Dorsally the basal region in extrusion has two conspicuous papillæ, each surmounted by a large brown tooth (VI), and on the fold between them are two or three smaller teeth (V). The folds are thirteen in number, and ventrally have minute paragnathi arranged on two sides of each triangular area (VII and VIII), the apex being in front. In some each area is tinted brownish. Dorsally in the maxillary region is a group of small teeth (II) on each side, ventrally in the same region are rows of small paragnathi generally forming a somewhat elongated area (IV) on each side, whilst between them is a considerable group of small paragnathi (III).

The first foot is characterized by the greater proportional bulk of the cirri; setigerous lobe massive. About the thirtieth foot a considerable dorsal elevation appears, and continues to the posterior end. It is marked by opaque granular glands. The characteristic foot occurs near the fifty-seventh, in which the dorsal region—comprising the dorsal lobe and the dorsal cirrus—is greatly hypertrophied, extending by-and-by, *e g.*, at the sixty-eighth, as a long lamella with the cirrus at the tip. The bristles are of two kinds, the tapering tips of the homogomph being somewhat short, as are also those of the heterogomph.

[1] 'Beitr. Fauna Norweg.,' p. 161, Taf. viii, f. 6—8, 1843.

[2] 'Nouv. Arch. Mus.,' p. 148, 1901.

Synonyms.

1833. *Nereis Marionii,*[1] Aud. & Edw. Ann. Sc. Nat., t. xxix, p. 207, pl. xiii, f. 1—6.
1834. ,, ,, idem. Annél., p. 185, pl. iv A, f. 1—6.
1847. ,, *succinea,* Frey and Leuckart. Beiträge, p. 154, Taf. ii, f. 9 and 11.
1851. ,, ,, Grube. Fam. Annel., pp. 49 and 127.
1865. ,, *Marionii,* De Quatrefages. Annel., p. 549.
,, ,, *crassipes,* idem. Ibid., p. 550.
1867. *Stratonice Marioni,* Malmgren. Annul. Polych., p. 56.
1868. *Nereis lamellosa,* Ehlers. Börstenw., ii, p. 564, Taf. xxii, f. 10—17.
,, ,, *succinea,* idem. Ibid., ii, p. 570, Taf. xxii, f. 18—22.
1870. ,, (*Lipephile*) *macropus,* Claparède. Annél. Nap. Suppl., p. 80, pl. viii, f. 1.
,, ,, *Marionii,* Grube. Arch. f. Naturges., Bd. xxxvi, p. 305 (?).
,, ,, *crassipes,* idem. Ibid., p. 304.
1885. ,, *lamellosa,* Carus. Fauna Medit., p. 221.
1898. ,, *longipes,* De St. Joseph. Ann. Sc. Nat., 8e sér., t. v, p. 314, pl. xvii, f. 107—112.
1902. ,, *Marionii,* McIntosh. Ann. Nat. Hist., ser. 7, vol. x, p. 256.
1908. ,, (*Neanthes*) *succinea,* Horst. Notes Leyden Museum, vol. xxx, pp. 215—218, Text-figs. 1–4.
1909. ,, ,, ,, idem. Tijdschr. Nederl. Dierk. Vereen. (2), xi, p. 144.

Habitat.—In galleries in cracks of rocks, St. Peter Port, under stones at Perrelle Bay, Guernsey, and in similar places in Herm. South of England, Plymouth (Allen). Shores of France (Milne Edwards and De St. Joseph); Naples (Claparède).

Head (Plate LX, fig. 9) marked by dark pigment on the dorsum, but with a pale posterior margin so as to be abruptly defined from the peristomial segment. Eyes not larger than in other species of *Nereis,* and having the same position; brownish, with a black speck in the centre, the anterior pair with lenses, and occasionally a minute lens in the posterior. Dorsal of the first or upper pair of tentacular cirri longest, the cirrophore being greenish, the ventral much shorter in proportion than in the other species, and in addition rather thick. The other pair is longer than the latter, but shorter than the former, the dorsal slightly exceeding the ventral in length. All the cirri are somewhat short. The peristomial segment is about twice as broad as the succeeding.

Body 3—4 ins. long, slightly tapered anteriorly, but more distinctly posteriorly, where it terminates in two short cirri.[2] The peristomial segment is about twice as broad as the succeeding. In large examples the dorsum anteriorly is dull olive green, paler green posteriorly, the tints being the more pronounced from the pallor of the feet and their processes, as well as from the whitish patch in front of each foot. There is also a little white pigment in the median line of the dorsum. Though supplied with blood-vessels, the lobes of the posterior feet appear to be pale, and this, with the whitish pigment at the base, aids in the discrimination of the species. About the thirtieth foot a considerable dorsal elevation at the base of the foot occurs, and continues to the posterior end of the body. It is marked by the same opaque granular glands as are found in the dorsal

[1] Named after Dr. Marion de Procé, a naturalist and physician of Nantes. The Scottish University Commissioners of 1889 do not encourage such talent in the department in our country.

[2] In some four short filaments on each side of the vent (De St. Joseph).

lobe of the foot itself. In spirit-preparations these give a character to the region, as in *N. Dumerilii*.

The *proboscis* (Plate LX, fig. 9) has a pair of strong, curved maxillæ with about five or six serrations on the edge, a considerable portion of the tip being smooth. The paragnathi are somewhat feebly developed, and apparently lose their brownish hue after long preservation in spirit. Dorsally in front of the palpi (*i.e.*, on the basal segment) are two conspicuous papillæ, each surmounted by a brown tooth (VI), and it may be one or two smaller externally, transversely elongated at the base but pointed distally, and on the folds between them are two or three smaller (V), though occasionally the solitary anterior one is large. When the proboscis is half extruded these two papillæ are very prominent, and the edge of the proboscis at this stage of extrusion has thirteen crenations, each furnished with minute paragnathi (VII and VIII). Those on the ventral surface are arranged along two sides of a triangle, the apex being in the centre and toward the outer border of the papilla. In some preparations this triangular area is tinted brownish and thus sharply marked off from the proximal continuation of the fold, and from the distal part of the fold forming the papilla in semi-extrusion. In the latter condition an inner ring of six papillæ occupies the centre, viz., two large lateral on each side, and a smaller papilla dorsally and ventrally.

The maxillary region presents dorsally a group of small teeth (II) on each side; ventrally in the same region are rows of small paragnathi forming a somewhat elongated area (IV) on each side, whilst between them is a considerable group of small paragnathi (III). The figure made by the artist from a bleached specimen is somewhat abnormal, for it shows two large paragnathi with two or three smaller internally (VI), and only a single small posterior tooth in V, instead of the foregoing typical arrangement. The variations of the paragnathi in this species are sufficiently evident by referring to the figures of Ehlers, and more recently those of De St. Joseph as indicated in the list. The foot in such a case is, perhaps, individually more diagnostic than the paragnathi.

The first foot (Plate LXXII, fig. 3) essentially differs from that of both *Nereis pelagica* and *N. cultrifera* by the greater proportional bulk of the cirri. The dorsal edge of the foot is short, and the short and massive dorsal cirrus extends considerably beyond the dorsal lobe. The latter is large and bluntly ovate. The setigerous lobe beneath (corresponding to the ventral setigerous lobe) is massive and projects much further than in *N. cultrifera*, with which it agrees in being bifid. It bears dorsally a group of bristles with slender tips of moderate length and finely spiked on the edge. The shafts have less distinct transverse bars than in the former species. Beneath is a series of bristles with short tips, the oblique part at the base being long, and curved near the prominent anterior spur, whilst the spinous edge is curved and the tip scarcely hooked. The shafts show a double camerated streak superiorly and a single one below the dilated region. The inferior and larger group of bristles in this lobe corresponds in structure with the latter. The spinous edges of all the bristles are directed upward in the preparation. Besides the smaller upper and the larger inferior papilla of this lobe, the ventral edge presents a distinct prominence.

The ventral lobe does not project as far as the setigerous, and is elongate ovate in

outline. The ventral cirrus arises at its base and extends somewhat beyond it. Its proportions are large. A single spine passes to the furrow between the larger and smaller terminal papillæ.

The tenth foot (Plate LXXII, fig. 3 *a*) has a slightly tumid upper border with a faint depression at the origin of the dorsal cirrus. The dorsal lobe forms a short, broad cone, and is therefore less blunt than in the first foot. A dorsal setigerous lobe appears as a small papilla below the former, and it bears a tuft of bristles with slender tapering tips and a spinous edge (Plate LXXXI, fig. 3). These have rather shorter tips than in the two foregoing species, viz., *N. pelagica* and *N. cultrifera*. Beneath is a somewhat bluntly rounded lobe. The inferior setigerous lobe has the characters mentioned in the first foot, viz., a small dorsal papilla, then a larger blunt process followed inferiorly by a projecting rim under the bristles. The upper bristles of this lobe conform to those of the dorsal division, whilst beneath is a dense group of stout bristles (Plate LXXXI, fig. 3 *a*) with short tips, which may form a palisade of uniform length. The terminal piece is slightly curved at the tip, and has a less projecting anterior inferior angle than in *N. cultrifera*, and a spinous edge. The shaft shows two camerated streaks in the centre. The inferior lobe is tongue-shaped with a blunt tip which does not extend so far outward as the setigerous lobe above it. The ventral cirrus is considerably shorter than the dorsal and does not reach the extremity of the ventral lobe.

The lobes of the foot undergo considerable changes, so that at the thirty-seventh the dorsal becomes both diminished and pointed (Plate LXXII, fig. 3 *b*), the dorsal cirrus is carried somewhat further outward, and is, compared with the lobe, proportionally large. The upper setigerous lobe beneath is more distinctly seen than in the tenth foot and is bifid. It bears similar bristles. The ovate lobe beneath is also considerably diminished, and does not extend so far outward as the dorsal. The inferior setigerous process has rather increased in lateral view, but projects less, and the distal end is more uniform, only the small papilla at the upper bristles being prominent. The bristles are unaltered. The tongue-shaped ventral lobe is much less, but it approaches the tip of the setigerous lobe above more closely, since the latter is less prominent. The diminution of the foregoing lobes brings the tip of the small ventral cirrus nearly in a line with that of the adjoining lobe.

At the fifty-seventh foot (Plate LXXII, fig. 3 *c*) a great development of the region between the base of the dorsal cirrus and the body has ensued, so that the diminished dorsal cirrus with the minute lobe beneath is thrust far outward—as the terminal parts of the great flattened vascular lamella thus formed. The dorsal border is occupied by granular glands (Claparède's granular follicles), and similar opaque matter occurs at its inferior edge. The spine and two bristles mark the dorsal setigerous lobe, but no papilla is visible. The lobe beneath is about the same size as in the thirty-seventh foot. The inferior setigerous lobe is rather less and has fewer bristles. Moreover the upper two or three bristles with short tips have proportionally increased in size. The ventral lobe and the cirrus are somewhat less.

The elongation of the upper region of the foot is fully developed at the sixty-eighth foot (Plate LXXII, fig. 3 *d*) where it forms a greatly elongated vascular process, the base of which occupies fully half the foot in lateral view. The region, indeed, forms a long

cone with glands dorsally and ventrally and a great blood-vessel in the centre. The short dorsal cirrus is now at the tip of the region, in a line with the dorsal border, a small rounded papilla beneath indicating the dorsal lobe. The dorsal setigerous lobe is represented by its bristles and the spine. The lobe beneath is considerably less. The inferior setigerous lobe and the parts beneath have the same character as in the previous foot.

Behind the sixty-eighth the characters of the foot present little alteration, even to the tip of the tail. The greatly elongated and very slightly tapered dorsal region has the short cirrus at its extremity, and the deeper angle at its base inferiorly is now the only trace of the dorsal lobe. The upper setigerous lobe is represented by its spine and a few bristles. The lobe beneath is ovate, but its base encroaches on that of the region above it. The inferior setigerous lobe is conical, the longer slope being ventral. The ventral lobe is small, but of similar shape to that in the sixty-eighth foot. The ventral cirrus projects as far as the tip of the setigerous lobe above it. The vascularity of the entire foot is great, so that the posterior region of the animal is thus provided with a series of leaf-like organs for aiding, along with the other parts of the foot, in respiration. The bristles preserve the same characters as in the sixty-eighth foot; two of these in the inferior series with short tips arise above the spine, and are stronger than the others.

Habits.—This species is less active than *Nereis pelagica*, *N. cultrifera*, or *N. Dumerilii*, and is considerably smaller than the two former species.

An example from Falmouth in the British Museum is labelled *Nereis fimbriata*. Considerable confusion, indeed, has occurred in the synonymy of this species, the characters of which, however, are, on the whole, distinctive. The variability and comparative feebleness of the paragnathi, and their tendency to become indistinct in spirit-preparations, may also have tended to create doubt. These remarks are suggested by the fact that Baron De St. Joseph, whose admirable work on the Annelids of Dinard and generally of the shores of France has done so much to clear up the subject and increase our knowledge of the group, does not include *Nereis Marionii*, Aud. & Edw., in his comprehensive series. Yet he constitutes two new species for forms having the closest resemblance to that of Audouin and Edwards. The first of these is one which he places under the genus *Neanthes* of Kinberg, viz., *Nereis* (*Neanthes*) *Perrieri*,[1] which he procured at Villerville and Villers on the shores of France. It is true the longest tentacular cirrus is longer than that usually found in *N. Marionii*, and the paragnathi show certain differences, but, as Horst[2] has already pointed out, a considerable margin should be allowed for variation, and he is of opinion that this form is only the *Nereis succinea* of Leuckart, a form here considered synonymous with *Nereis Marionii*, Aud. & Edw.

The second species, viz., *Perinereis longipes*, he doubtfully associates with the *Nereis crassipes* of De Quatrefages[3] and of Grube's[4] critique on the Annelids in the Parisian Museums; but it appears to be this form (*Nereis Marionii*), so well known in the Mediterranean, on the southern shores of England, and in the Channel Islands. De St.

[1] 'Ann. Sc. Nat.,' 8e sér., t. v, p. 288, pl. xv, figs. 69—77, 1898.

[2] *Vide* p. 301.

[3] 'Annelés,' i, p. 550.

[4] 'Arch. f. Naturges.,' 1870, p. 305.

Joseph procured his specimens at Guéthary and St. Jean-de-Luz under stones, and at St. Anne near d'Hendaye in *Melobesia agariciformis*.

The original description with its excellent figures by Audouin and Edwards,[1] drawn up from a specimen from La Vendée, sent by Dr. Marion de Procé, a physician and naturalist of Nantes, places the identification of this species beyond doubt, though the paragnathi are not alluded to. That so competent a successor, therefore, should have been unable to satisfy himself of the relationship is not easily explained, even though the absence of the original example should have made some obscurity. The description De St. Joseph gives of the body, the head, and its organs, the changes in the structure of the feet—especially the remarkable increase of the dorsal process with the cirrus at the tip (which Audouin and Edwards regarded as branchial in function), as well as the structure of the bristles—all apply to *Nereis Marionii*. The great variability in the details of the paragnathi of *N. Marionii* probably has given rise to ambiguity in the absence of a description or reference to the original specimen. Moreover, the changes after long preservation are considerable. In every British example Group VI is represented by a prominent conical tooth, or by a transverse bar, akin to that indicated as typical of *Perinereis longipes* by De St. Joseph. This, from its somewhat conical outline, is prominent during the partial protrusion of the proboscis, as it is elevated on a papilla. In the centre between there is (V) a single conical tooth, with a somewhat irregular series of smaller points "dusted" between the larger pair (VI). The large number of very minute specks shown in De St. Joseph's figure (Plate XVII, fig. 110) is apparently a variation. In some of the British forms Group V consists of a central in front and two or three similar ones behind, with a few smaller dotted around. Groups I and II on this aspect, viz., those near the base of the maxillæ in extrusion, are after the plan shown by De St. Joseph. From the outer border of each of the larger posterior paragnathi (VI) a dotted series runs to the ventral surface, and occasionally a line of paragnathi leaves Group V on each side in the same direction. These lead to the basal ventral series VII and VIII, arranged in lozenges after the manner shown by De St. Joseph (fig. 112), though in the British specimens the minute points are less numerous. The teeth in the maxillary (distal) region, near the base of the maxillæ on the ventral surface (Groups III and IV), are fewer in number, but have a similar arrangement to that figured by De St. Joseph. The author, indeed, observes that the proboscis approaches that of *Perinereis Marionii*, but that species has three dorsal lobes to the foot (as figured by Audouin and Edwards ?). So far as the British examples go, however, the structure does not differ from that given by De St. Joseph, and it may be that Grube was right in considering *Nereis crassipes*, De Quatrefages, as the young of *N. Marionii*, which, according to his descriptions, seems altogether to have eluded the careful search of the French shores by De St. Joseph. *Perinereis longipes*, De St. Joseph, therefore, as well as *Nereis Perrieri*, is regarded as a synonym of *Nereis Marionii*, Aud. & Edw.

The *Nereis Ockenii*[2] (the *N. ottoana* of the 'Descrizione'[3]) of Delle Chiaji may have some connection with this species, if it is not identical. His artist may have made

[1] 'Annélides,' p. 185, pl. iv *a*, figs. 1—6, 1834.

[2] 'Memorie,' iii, pp. 166 and 175, Tav. xlii, figs. 2, 12, and 20, 1828.

[3] Tomo iii, pp. 96 and 103, v, p. 102, Tav. 96, figs. 7, 12, 17, 20, 21.

long lamellæ anteriorly as well as posteriorly, for he was by no means scientifically accurate.

Frey and Leuckart (1847) describe and give figures of a new species, *Nereis succinea*, from Heligoland, which appears to correspond most closely with the present form.

Grube's *Nereis vexillosa*[1] from the shores of Eastern Siberia (near the Amoor) is an allied form, and his *Nereis arctica* may be its epitokous stage.

The characteristic condition of the dorsal lamellæ of the feet posteriorly induced Malmgren (1867) to institute the genus *Stratonice* for this species.

Ehlers (1868) apparently refers to this form under two titles, viz., *Nereis lamellosa* from the Adriatic, and *Nereis succinea* of Leuckart from Cuxhaven and Norderney. The differences in the paragnathi are due to mere variation, as formerly explained. Both have short tentacles and tentacular cirri, and the form of the foot is characteristic.

Claparède (1870), in his account of this form, his *Nereis macropus*, omits reference to *Nereis Marionii* (Aud. & Edw.), the resemblance having apparently escaped him for the moment. The shortness of the tentacles and the general aspect of the head, the armature of the proboscis, the nature of the feet, bristles, and other parts are more or less identical with *A. Marionii*. He truly considered the greatly elongated dorsal lamella as an aid to respiration, his figures bearing out his interpretation, and he alludes to other forms in which the superior lamella is largely developed, *e.g.*, *Mastigonereis*, Schmarda, *Pseudonereis*, *Paranereis*, *Perinereis*, and *Mastigonereis*, Kinberg, though he does not approve of the latter author's classification.

It is remarkable how closely *Nereis melanocephala* of the 'Challenger' approaches the British species, which probably has a much wider distribution than is at present supposed. Slight variation may explain the differences in paragnathi and other respects which are held to be of specific importance.

Gravier's[2] (1901) *Pseudonereis anomala*, from the Red Sea, is another form which closely approaches this species.

An interesting criticism, with four good figures, on this species, as the *Nereis* (*Neanthes*) *succinea* of Leuckart, and the *N. Perrieri* of De St. Joseph, has recently been made by R. Horst,[3] who had the advantage of examining the original specimen of Leuckart, as well as those of Metzger and others, in the collection of Ehlers. He comes to the conclusion that these are one and the same species, and that the limited geographical distribution no longer holds. If, however, he had included other synonyms in his review, this distribution would have been still further extended.

The form termed *Nereis glandulosa* by Ehlers[4] approaches this form in the structure of the feet and other features, but it does not appear to be identical, though too much reliance should not be placed on the paragnathi.

[1] 'Mém. des Sav. étrang.,' St. Pétersb., viii, p. 4, pl. ii, figs. 1, 5, and 6.
[2] 'Nouv. Arch. Mus.,' 4e sér., t. iii, p. 191, t. ii, pl. xii, figs. 50—52.
[3] 'Notes from the Leyden Museum,' vol. xxx, p. 215, 1908.
[4] 'Deutsch. Tiefsee Exped.,' p. 74, Taf. viii, figs. 1—6, 1908.

5. Nereis dumerilii, *Audouin & Edwards*, 1833. Plate LII, fig. 5; Plate LX, figs. 10–10 *c* —head, etc.; Plate LXXII, figs. 4–4 *f*—feet; Plate LXXXI, figs. 4–4 *c*—bristles.

Specific Characters.—Head of the normal shape with four large eyes. Occasionally the elevated central region has a wedge-shaped patch of white from the posterior pair of eyes to the tip. Tentacles of moderate length. Tentacular cirri long, ranging from one third the length in small examples to one fifth the total length in larger; the longest is the dorsal of the second pair. Body $2\frac{1}{2}$ ins. long, and of seventy to eighty segments. Colour, various shades of yellowish-brown, enlivened by the red dorsal vessel. Anterior fifth of the dorsum minutely dotted with brown, and more brightly iridescent than the rest of the dorsum. Minute white grains occur over the central vessel. Behind the anterior fifth white grains are distributed over the whole dorsum. Occasionally small specimens are greenish-yellow, and have rather large yellow grains. Ventral surface greenish anteriorly, the rest of the same hue as the dorsum. Proboscis has two slightly translucent amber-like maxillæ with six teeth. Paragnathi comparatively feebly developed. Dorsally the maxillary segment in extrusion has in the ordinary examples no paragnathi, but a short double row of small paragnathi (II) occurs on each side. Ventrally a patch of oblique but parallel pectinate rows of minute denticles, the whole having a somewhat triangular outline and a rasp-like surface, occurs near the base of each maxilla (IV), and between are two rows of minute denticles (III). The proximal segment has dorsally two patches of paragnathi (VI) in front of the palpi, each composed of about two rows of minute points. Ventrally each lozenge-like area has two rows (VII and VIII) of minute paragnathi.

The first foot has a proportionally large and long dorsal cirrus and three rather long lobes, besides the setigerous process. A tendency to the increase of the dorsal region is apparent at the thirty-seventh foot and becomes conspicuous at the fifty-seventh, with the presence of two opaque glandular masses in each foot. The ventral cirrus is somewhat short throughout. Bristles homo- and heterogomph, the former with tapering, boldly spinous terminal pieces, the latter with short tips, and a very short spinous edge.

Epitokous Form.—The head in the epitokous male is short and rounded, the large, sometimes connate, eyes occupying the lateral regions. Body soft and delicate. Dorsal cirri of the first seven segments dilated and peculiarly modified. The ventral cirri of the corresponding feet are also dilated. At the compressed sixteenth foot the lamellæ appear, and the pelagic condition is fully developed at the thirty-seventh foot, the great lobes being very thin, and finely and somewhat regularly veined. The dorsal cirrus has a series of prominent papillæ on its lower edge. The long swimming bristles give a glassy sheen to the sides.

Synonyms.

1833. *Nereis Dumerilii*, Aud. & Edw. Ann. Sc. Nat., t. xxix, p. 218, pl. xiii, f. 9—12.
1834. „ „ idem. Annél., p. 196, pl. iv A, f. 10—12.
1840. „ „ Johnston. Ann. Nat. Hist., v, p. 174.
„ „ „ Grube. Actin. Echin. u. Würm., p. 73.
1843. „ „ H. Rathke. Beiträge Fauna Norweg., p. 163, Taf. vii, f. 4, 5.

1843. *Nereis zostericola,* Œrsted. Annul. Danic. Consp., p. 22, f. 20, 29, 67, 70, 71, 74.
1844. „ *Dumerilii,* Thompson. Rep. Brit. Assoc., 1843, p. 273.
1851. „ „ Grube. Fam. Annel., pp. 48 and 125.
„ „ *zostericola,* idem. Ibid., pp. 49 and 125.
1865. „ *Dumerilii,* Johnston. Cat. Worms Brit. Mus., pp. 156 and 341.
„ „ „ De Quatrefages. Annel., p. 502.
„ „ „ Carrington. Annel. Southport, p. 8.
1867. *Leontis Dumerilii,* Malmgren. Annul. Polych., p. 52. Taf. iv, f. 25.
1868. „ *peritonealis,* Claparède. Annél. Nap., p. 157.
„ „ „ Ehlers. Borstenw., ii, p. 535, Taf. xx, f. 21—37.
1869. „ *Massiliensis,* Moquin-Tandon. Ann. Sc. Nat., 5e sér., t. xi, p. 134.
1870. „ *peritonealis,* Claparède. Annél. Nap. Suppl., p. 44, pls. iii—vi.
„ *Nereis Dumerilii,* Grube. Arch. f. Naturges., Bd. xxxvi, p. 308.
1873. „ „ Kupffer. Exped. Ostsee, 'Pommerania,' p. 150.
„ *Leontis* „ Sars. Bidrag Christ. Fauna, p. 22.
1874. „ „ Malm. Göteb. vet. o. vitt. Handl., xiv, p. 84.
„ *Nereis* „ McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 199.
1875. „ „ Marion and Bobretzky. Ann. Sc. Nat., 6e sér., t. ii, p. 16.
„ „ „ Möbius. Jahresb. Comm. deutsch., ii, p. 168.
„ „ „ McIntosh. Invert. and Fishes St. Andrews, p. 122.
1878. „ „ Lenz. Jahr. Comm. deutsch., iv, Anhang., p. 12.
1879. „ „ Webster. Trans. Albany Inst., ix, p. 34.
„ „ „ Marenzeller. Sudjap. Annel., p. 123, Taf. ii, f. 4.
„ *Leontis* „ Langerhans. Zeitschr. f. wiss. Zool., xxxiii, p. 281.
„ *Nereis* „ Tauber. Annul. Danic., p. 98.
1881. *Leontis* „ Langerhans. Canar. Annel. in Nova Act. Leop., p. 110.
1883. *Nereis* „ Levinsen. Vidensk. Meddel. Foren. Kjöben., p. 235.
1885. „ „ Carus. Fauna Medit., p. 220.
„ *Leontis* „ McIntosh. Annel. 'Challenger,' p. 221.
1890. „ „ Malaquin. Annél. Boulon, p. 27.
1891. *Nereis* (*Leontis*) *Dumerilii,* Hornel. Trans. Biol. Soc. Liverp., vol. v, p. 241.
1893. „ *Dumerilii,* Levinsen. Vidensk. Ud. 'Hauchs,' p. 329.
1895. *Leontis* „ De St. Joseph. Ann. Sc. Nat., 7e sér., t. xx, p. 214.
1896. *Nereis* „ Racovitza. Arch. Zool. expér., 3e sér., iv, p. 217, pl. iv, f. 35—39.
1901 „ „ Wistinghausen. Mitth. Zool. Stat. Neap., t. x, p. 47, pls. vi and vii.
1902. „ „ McIntosh. Ann. Nat. Hist., ser. 7, vol. x, pp. 256 and 258.
1904. „ „ Allen. Journ. M. B. A., N.S., vol. vii, p. 224.
1905. „ „ Graeffe. Arbeit. Zool. Stat. Triest, xv, p. 322.
1906. *Platynereis Dumerilii,* De St. Joseph. Ann. Sc. Nat., 9e sér., t. iii, p. 222.
„ *Nereis* „ Eisig. Fauna u. Fl. Neap., xxviii, p. 208.
1909. „ „ Elwes. Journ. M. B. A., N.S., vol. viii, p. 351.

Forma epitoca.

1843. *Heteronereis fucicola,* Œrsted. Annul. Danic. Consp., p. 19, f. 17, 55—58, 61, 62.
„ „ *viridis,* idem. Ibid., p. 20 (?).
„ *Nereilepas variabilis,* idem. Ibid., p. 20, f. 18, 26, 51, 52, 54, 59, 60.
1851. *Nereis fucicola,* Grube. Fam. Annel., pp. 50 and 127.
1865. *Heteronereis fucicola,* De Quatrefages. Annel., p. 574.
„ *Iphinereis* „ Malmgren. Nord. Hafs-Annul., p. 182.

1867. *Iphinereis fucicola,* idem. Annul. Polych., p. 58, Taf. v, f. 29, 30.
1868. *Heteronereis Malmgreni,* Claparède. Annél. Nap., p. 173, pl. xi, f. 1.
1870. „ *fucicola,* idem. Annél. Nap. Suppl., pl. iii, f. 4, 5.
1874. *Iphinereis fucicola,* Malm. Göteb. vet. o. vitt. Handl., xiv, p. 84.
„ *Heteronereis viridis,* idem. Ibid., p. 85.

Habitat.—Abundant on both the eastern and western coasts of the British Islands, though its headquarters are on the western and the southern shores. On the east coast, as at St. Andrews, it generally occurs in deep water or is tossed on shore by storms, its tubes being attached to the empty valves of *Cardium echinatum* and other mollusks. Off the western shores it frequents both deep and shallow (laminarian) zones, being especially common in the latter in four to six fathoms. Its tough tubes are often met with in the interior of decayed laminarian stalks, or in peat, whilst one took advantage of a partially open egg-capsule of a skate. In Loch Portan, near Lochmaddy, where there is a considerable admixture of fresh water, the tubes (with the annelids in the interior) are common. In deep water they are often fixed to the large red Ascidians of the Minch and other western seas.

In the south, as in the Channel Islands, it seems to take the place of *Nereis pelagica* of the north, and is found in crevices and fissures of the rocks between tide-marks, as well as in the adjoining sea. It is not uncommon in the stomachs of cod and haddock in St. Andrews Bay, especially the epitokous *Iphinereis fucicola* (E. M.). It occurs on the eastern, western, and southern shores of Ireland (*e. g.* Loch Slyne, Co. Cork, Roy. Irish Acad. Exped., 1866); Bay of Galway (Prof. E. P. Wright).[1]

It is very plentiful in the Mediterranean, and since it ranges to Norway and Sweden its distribution is wide: Black Sea (Bobretzky); St. Vincent, Cape Verde Islands; Japan (Marenzeller); Norway (Malmgren); Canaries (Langerhans); Virginian coast (Webster).

Head longer than broad, with four large and sometimes reddish eyes, the anterior pair wider apart. In a few preserved examples a little pigment occurs on each side in front of them. In some from deep water the elevated central region has a wedge-shaped patch of white, with a median furrow running from the posterior pair of eyes to the tip of the snout. The tentacles are of moderate length and subulate. The long tentacular cirri, for which the species is remarkable, range from rather more than one fifth the entire length of the annelid to one third in small examples, and are pale greenish. These tentacular cirri are obliquely situated, the longest being the most posterior and dorsal.

Body $2\frac{1}{2}$ ins. in length and of seventy to eighty segments. Colour, yellowish-brown on the dorsum, some being more deeply tinted than others, and marked by the red dorsal vessel. The surface of the anterior fifth is minutely dotted with brown, and more brightly iridescent than the rest of the dorsum. At every segment-junction minute white dots occur over the central vessel. Behind the anterior fifth minute white grains are distributed over the whole dorsum, and very distinctly towards the tip of the tail, which is terminated by two long cirri. The tips of the feet (not the cirri) are whitish in the caudal region and for some distance forward. Some small specimens from deep water are of a greenish yellow, the dorsum being speckled with rather large yellow grains, which over the region tinted brownish by the intestine are arranged in two rows.

[1] The recent death of this genial naturalist deprives both zoology and botany of an ardent worker.

Anteriorly greyish-brown grains are mingled with the yellow. In preserved specimens the two opaque, brownish, granular, glandular bodies on the dorsum of the foot are visible about the tenth foot, and are very conspicuous posteriorly, where one or two dots also occur on the side above the foot. Ventral surface greenish anteriorly, the rest being similar to the dorsum, but without the white grains.

The *proboscis* (Plate LX, figs. 10, 10 *a*, and 10 *b*) has two slightly translucent maxillæ, like amber, with six teeth pointing or sloped distally. The paragnathi are comparatively feebly developed, and they become very indistinct in some after long preservation in spirit. On the dorsum of the organ in extrusion are two patches (VI) in front of the palpi, each composed of about two rows of minute points. No teeth occur on this surface in the maxillary division at the base of the jaws in the ordinary examples, but in the epitokous forms (Plate LX, fig. 10 *b*) a short double row of small paragnathi (II) are met with on each side. On the ventral surface the proximal region of the organ presents two rows of minute paragnathi (VII and VIII) at the outer end of each lozenge-shaped area, whilst on the maxillary division a patch of oblique but parallel rows of similar minute denticles (IV), the whole having a somewhat triangular outline, occurs near the base of each jaw. In the middle line between these are two rows (III) of minute denticles. Considerable variation is met with in the arrangement of the paragnathi on the various areas.

The first foot (Plate LXXII, fig. 4) has a long and proportionally large dorsal cirrus, which extends fully a third of its length beyond the dorsal lobe. The latter is of an elongated tongue-shape, slightly diminished at the tip. Beneath it and partly overlapping the setigerous lobe is a smaller elongate lobe, also diminished at the tip. A small papilla occurs opposite the elongated lobe just mentioned. The setigerous lobe bears a series of bristles with long tapering tips. The shafts have a single camerated band in lateral view, and in the comparatively small bristle these are faintly marked. The sabre-shaped tip is not much tapered and has a finely spinous edge. The ventral lobe projects considerably beyond the setigerous, but not so far as the two upper lobes. It also is tongue-shaped, with a long inferior border. The ventral cirrus is smaller than the dorsal, its tip reaching to that of the lobe above it. The foot thus differs from that of any of the preceding species. A single spine, as usual, is present.

At the tenth foot (Plate LXXII, fig. 4 *a*) the lobes have become more obtuse, the upper being the more prominent, as the outline slopes from above downward and inward. The edge of the foot from the body to the dorsal cirrus is longer and the ridge more convex. The dorsal cirrus is still large, though less in proportion to the bluntly conical dorsal lobe, which has considerably increased in bulk. A dorsal setigerous lobe or papilla is now present, but, as it lies in front, is not included in the outline shown in the figure. The lobe beneath is a massive blunt cone, its base overlapping the inferior setigerous lobe, which is somewhat posterior in position. The latter has one long papilla and a projecting edge inferiorly. The upper group of bristles has tapering and boldly spinous tips (Plate LXXXI, fig 4), besides others with short tips, the spinous edge being very short (Plate LXXXI, fig. 4 *a*). A double line occurs below the hooked tip as if a differentiation were indicated. Ehlers' figure differs from the condition in our examples. The camerated central region is less distinct than in *Nereis pelagica* or *N. cultrifera*.

The ventral lobe is bluntly ovate and the small ventral cirrus does not extend so far outward as its tip.

At the thirty-seventh foot (Plate LXXII, fig. 4 *b*) a considerable increase in length has occurred, both by the elongation of the region between the body and the dorsal cirrus, and the elongation of the lobes themselves. The dorsal cirrus is still long, and has two opaque glandular masses near its base. The dorsal lobe forms a long triangle, and the superior setigerous lobe is indicated by two small papillæ in the sulcus. The next lobe is nearly lanceolate, though there is an elevation on its ventral border near the base. The inferior setigerous lobe forms a truncated cone (though in the larger specimens a longer, pointed papilla and a shorter are present) bearing bristles with tapering tips superiorly and those with short tips inferiorly. The ventral lobe is tongue-shaped, and the ventral cirrus small, only reaching to the middle of the lobe above it.

The general size of the foot is diminished at the fifty-seventh (Plate LXXII, fig. 4 *c*). The dorsal border is convex and is entirely occupied by the opaque granular bodies now in close apposition. The dorsal lobe does not differ much from the condition in the thirty-seventh foot, forming a long, lanceolate process. The superior setigerous lobe has at least one prominent papilla. The next lobe is elongate-lanceolate as in the thirty-seventh foot, only the inferior elevation is less. The inferior setigerous process is conical with a long and a short papilla, the latter for the spine. The ventral lobe is tongue-shaped, and the cirrus is somewhat longer than in front. The upper bristles with short tips are considerably stronger than those beneath them.

At the seventy-seventh foot the lobes, especially the two upper, are larger in proportion. The opaque granular bodies have fused into one great mass which encroaches on the base of the dorsal lobe. The other parts of the foot are similar to the fifty-seventh. The upper bristles with short tips in the inferior setigerous lobe remain stronger than those beneath, as if in this region of the body they had a special function—probably in connection with the tubicular habits of the species. A slight indication of a wing is observed beneath the hook in the form of a double line at the margin.

In the epitokous form (*Iphinereis fucicola*) the feet are furnished with long, translucent swimming bristles (Plate LXXXI, fig. 4 *b*) the terminal piece of which is thin and flat like the blade of a scalpel. The serrations on the edge (figured by Ehlers) were not definitely made out in these examples (long preserved). The shaft is equally translucent, and differs from that in the ordinary condition in having two stripes with the transverse bars or cameræ in the centre. Those bristles with short tips occurring in the epitokous forms are exemplified in Plate LXXXI, fig. 4 *c*, from the tenth foot. The head in these (Plate LX, fig. 10 *b*) has remarkably large eyes and long tentacular cirri, which in spirit show slight crenations.

The epitokous forms occur most plentifully in the warmer months, *e.g.*, in June. Their rounded heads, and large, often connate, eyes, which severally have lenses, are characteristic.

In a male heteronereid (Plate LX, fig. 10 *c*) the first fifteen feet (the average number) are little modified, except the dorsal cirri anteriorly. The head is short and rounded, the large eyes occupying the lateral regions and apparently having vision dorsally, laterally, and anteriorly. The softness and delicacy of the tissues, as pointed

out by Claparède, are diagnostic. In many the anterior region of the body has the segment-junctions transverse, whilst those behind slant from the middle line outward and backward, a feature observed in the heteronereid of *N. pelagica*. This, however, is not seen in those from which the genital products have escaped, and the bodies of which are semi-transparent.

The dorsal cirrus of the first foot is considerably dilated (Plate LXXII, fig. 4*d*) so that its dorsal outline forms a semicircle. The ventral cirrus is also similarly enlarged. Three elongated lobes appear in lateral view. The second foot is similar. The third has a tendency to an angular condition near the tip of the dorsal cirrus, from the abrupt cessation of the enlargement. In this foot, as usual, the two setigerous processes occur. The peculiar knobbed condition of the dorsal cirrus is more marked in the fourth foot and attains its maximum in the fifth and sixth (Plate LXXII, fig. 4*e*). In the seventh the cirrus, though longer, is more slender, and shows the angular process at the tip. The eighth on the right has a slender cirrus with the tip bent at an angle, whilst its fellow of the opposite side is normal, and so with the others which follow. The bristles are normal.

At the compressed sixteenth foot a decided change has taken place. An ovate lamella arises internal to the base of the dorsal cirrus, which is long and furnished with eight papillæ on its ventral border, the tip tapering from the last, which is longest. The dorsal lamella is long and lanceolate. The superior setigerous process ends in a blunt point, and some of the old bristles are present, the rest being swimming bristles. The lobe beneath it is lanceolate with a rounded spur at its base inferiorly. The inferior setigerous process is bifid, with an ovato-lanceolate lamella superiorly. Some of the old bristles remain in the superior tuft (homo- and heterogomph); the rest are swimming bristles. The ventral lobe is tongue-shaped. The ventral cirrus has an ovate lamella internally, and a small elongated one externally.

The pelagic foot is seen in full development at the thirty-seventh in those captured near the surface, as at Castlebay, Bona, on the 22nd May. The lobes of the feet are very thin and the sides glisten with the sheen of the large and long swimming bristles. Dorsally (Plate LXXII, fig. 4*f*) is the fan-shaped lamella close to the inner edge of the dorsal cirrus. The dorsal cirrus itself is long, with the papillæ (eight to ten) on the lower border, and distally the filiform tip. The dorsal lamella is lanceolate. The upper setigerous lobe is bifid and bluntly conical, the transparent bristles projecting from it in two groups. The lamella soldered to it inferiorly is broadly lanceolate with a heel at its inner and inferior border. The long inferior setigerous lobe has a huge lamella on its posterior face, stretching almost to the tips of the bristles, which project like a great fan. A long heel likewise extends inward from its base superiorly. The tongue-shaped ventral lamella leaves the stem of the former lobe and turns outward as a process with a spur on its upper border near the base. The ventral cirrus projects from a large fan-like lamella internally and a tongue-shaped one, with an upper heel, externally.

All the foliaceous lamellæ are finely and somewhat regularly veined from a midrib or a basal region. The venation appears to be due to granular canals (?) of the hypoderm. Many terminate between the pale end-organs at the margin of the lamella.

Little change occurs in the structure of the foot till near the tip of the tail, where the diminution in the size of the foot is marked. All the lamellæ become less; the dorsal

cirrus is shorter and devoid of the inferior papillæ. The bristles become few and long, but have the same structure.

Those captured in the pelagic condition at Barra were nearly uniform in size, viz., about 2 ins. in spirit. The vent is remarkably papillose.

A small example (about 1 in. in spirit) from the Mediterranean has very large eyes which are completely connate. The anterior region of the body has twenty-one segments of the ordinary structure. The rest are heteronereid. It probably is a male though the sexual elements are absent.

The males of this form seem to be more frequently met with than the females at St. Andrews—generally in March, and some reach fully 4 ins. If this is the male epitokous form of *N. Dumerilii* the radical change in the structure of the first foot is interesting.

In what appeared to be a small male from Plymouth the swimming lamellæ occur on the seventeenth foot, the thirteen anterior being large, and the fourteenth, fifteenth, and sixteenth smaller and more compressed, but having no foliaceous development or swimming bristles. The change is thus sudden. The eyes are large and connate and the anterior pair have lenses. The paragnathi are well developed.

The forms under which this species appears are: (1) The ordinary typical form which produces ova and sperms in separate individuals without change in the feet. (2) The same producing ova and sperms in the same individual. (3) The *Iphinereis* transformation with swimming lamellæ and bristles, and of separate sexes.

In a small specimen, probably about an inch when living or very little more, the eyes were as large as in the foregoing, and connate. There were fourteen feet of the ordinary form in front, the next were heteronereid. It came from Jersey (Mr. Hornell). Posteriorly the heteronereid condition abruptly ceased, and about a dozen of the terminal segments were of the ordinary form.

Reproduction.—At Naples Lo Bianco[1] found this annelid mature in August, and the larvæ in the tube from December to February and April to August. The *Heteronereis* condition occurred as a pelagic form from November to May.

A young example of *Nereis Dumerilii* captured in the tow-net by Mrs. Collings of Sark in July has thirty-seven feet. The jaws have eight or nine teeth. The anterior pair of eyes have lenses and are considerably larger than the posterior. They are transversely ovate, whereas the posterior pair are irregularly rounded. This may be an early example hatched the same season.

In a small example of fifty-six segments, and measuring little over half an inch in spirit, the eyes are considerably enlarged, and the dorsal cirri of the first seven segments form large clavate processes with the filiform tip. It seems to be a very small male. No change in the lobes of the feet or in the bristles have occurred. It was dredged in Tangiers Bay in thirty fathoms by the ‘ Porcupine ’ in 1870.

An interesting account of the earlier stages in the development of this species at Madeira is given by Langerhans (1879). He only found one out of several hundred examples in the *Heteronereis* condition. The eggs are whitish with a greenish point. The youngest larva he examined had three bristled segments, with a single dorsal and several ventral

[1] The recent loss of this able observer at the Zoological Station, Naples, is to be deplored both in the interests of science and of the workers there.

bristles, a head with four eyes, two frontal tentacles or papillæ, and rudimentary palpi. The proboscis is unarmed, and the rectum is differentiated. Two short anal cirri are present. He noted for some days the development of the parts and the increase of the segments to sixteen. He found that the armature of the proboscis appeared when there were eight or nine bristled segments. He describes the bristles of the early stages as embryonal, the tip being short with three spikes on the edge.

At St. Peter Port, Guernsey, in July, 1868, a female of the ordinary outline, and measuring about 2 in. in length, was laden as far forward as the fifth foot with large ova. These ova are larger than in the *Heteronereid* forms; indeed, about six or seven made up the diameter of the body. The eyes are of average size, and no change is apparent in the structure of the feet or bristles. This is an example of that condition in which the sexual elements are developed without external change.

A large female, again, of the ordinary type presents slightly enlarged eyes, but no change in the feet. The body-cavity is filled with small ova. Another procured in Birturbury Bay, Ireland, in June, is in the same condition, along with what appeared to be an epitokous female, since no papillæ occurred on the dorsal cirrus, but the specimen was so badly preserved that doubt remains. A few stray ova are seen, but their nature is doubtful.

Habits.—It is a less active species than *Nereis pelagica*, yet swims easily through the water in an undulating manner, without coiling the long tentacles. It rapidly secretes tubes even in a collecting bottle, and when deprived of them often enters those of Terebellæ or other forms. When in its own tubes in sea-water an undulating motion of the body is kept up, apparently for purposes of respiration, as in *Phyllodoce* and other annelids. The tubes in nature are tough, the mucus being strengthened by fragments of seaweeds and *débris*, and they are generally attached to Fuci and Laminariæ, as Œrsted originally found, though occasionally to other structures. It is somewhat brittle: even withdrawal from its tube suffices to cause fractures of the posterior region, and the same happens when placed in spirit. In the separated fragments the dorsal blood-vessel remains distended, and irregular contractions take place for some time.

At St. Peter Port, Guernsey, the tubes are sometimes stiffened by fragments of shells, both univalve and bivalve, Foraminifera, minute fragments of gneiss, particles of gravel, and fragments of Algæ and mud. At Lochmaddy, in the Outer Hebrides, besides the tough secretion and mud, the tubes are frequently strengthened and tufted with Algæ, and here and there a fragment of shell. Broad-leaved Algæ are often bound together by the secretions in Bressay Sound, besides tufts of filamentous Algæ, and the walls have many fragments of shells and occasionally fragments of Fuci. The tubes of some from Valentia Harbour, again, are hairy all over with filamentous Algæ. At Herm the tube of a small example with Algæ and fragments of *Trochus* attached was neatly placed inside the rim of a small *Haliotis* between tide-marks. An example has the palps soldered in the middle line, whilst the frontal tentacles are absent. Another from Norway shows the reproduction of a tail.

The *Lycoris cirrhosa* of Risso[1] (1826) appears to be allied to *Nereis Dumerilii*, with long tentacles and tentacular cirri, and may be that form.

[1] 'Hist. Nat. Europ.,' t. iv, p. 417.

So far as can be observed the *Nereis Beaucondrayi* of Audouin and Edwards[1] comes nearest this species.

The *Lycoris Dumerilii* of H. Rathke[2] (1837) probably refers to this form, though the figures are imperfect.

The *Nereis agilis* of Keferstein[3] (1862) appears to come nearest this species, though the figures show certain differences, probably due to the artist.

For similar reasons to those already mentioned under *Nereis Schmardæi* it is unnecessary to retain Malmgren's genus *Leontis* (1867) for this form.

The same author[4] pointed out the relationship of *Iphinereis fucicola*, Œrsted (*Heteronereis fucicola*, Auct.), with *N. Dumerilii*, viz., a sexual stage in its life-history.

Ehlers (1868) gives a careful description of this form both in its atokous and epitokous conditions, and in the different sexes. In the epitokous male he describes the cirri of the first four feet as enlarged at the base, the change of the feet occurring on the sixteenth, in the female on the twenty-first. The cirri in the female are simple; those of the male furnished with papillæ or warts.

Claparède (1868) describes *Heteronereis Malmgreni*, a pelagic Nereid from the surface of those currents which occur between Capri and Sorrento. The tissues are most delicate and the agility great in both males and females. The species is probably identical with the present. He gives fifteen segments to the anterior region (his thoracic) in the male, and twenty-two in the female. He draws attention to the ventral direction of the palpi, which are thus invisible from the dorsum, and notes that the form differs from *H. Œrstedi*, De Quatrefages, from Palermo, in so far as the median tentacle in the latter is biarticulate and the form of the foot different. Further investigation, however, is needed.

Moquin-Tandon[5] found at Marseilles a hermaphrodite Nereid, which he termed *Nereis massiliensis*, with spermatozoa and ova floating freely in the body-cavity. This apparently is the hermaphrodite form of *N. Dumerilii*, which occurs in a membranous tube amongst Ulvæ. He also found two under the same circumstances loaded with eggs only.

Claparède (1870) cites this form as one of the most puzzling of the group, for whilst forms of 13—14 mm. may be ripe, others of 50—60 mm. in length give no trace of sexual maturity. Again, at different epochs of their existence the males show sperms of totally different form. In his elaborate study of the Nereid and Heteronereid stages of this species he shows that there are five kinds of bristles in the Nereid, whereas in the pelagic Heteronereid there are but three, viz., the awn-like homogomph, the falcigerous heterogomph, and the sabre-like heterogomph. The falcigerous homogomph only appears at the twentieth segment. He has met with individuals possessing all the characters of Heteronereids, yet the bristles were Nereid. The presence of peritoneal pigment (purple, etc.), and the homogomph bristle in the inferior fascicle of the dorsal division of

[1] 'Annél.,' p. 192, pl. iv, figs. 1—7, 1834.

[2] 'Fauna der Koym.,' p. 419, Tab. vii, figs. 3, 16, and 17, 1837.

[3] 'Zeitschr. f. wiss. Zool.,' Bd. xii, p. 97, Taf. viii, figs. 8—11, 1862.

[4] 'Annul. Polych.,' p. 59, April, 1867.

[5] 'Compt. Rend.,' April 12th, 1869, t. lxviii, p. 869; 'Ann. Sc. Nat.,' 1869, p. 134; and 'Ann. Nat. Hist.,' 4th ser., vol. iv, p. 73, 1869.

about the twentieth segment, indicate the transformation. Careful examination of the interior of the feet discloses in these the flabelliform pelagic bristles in process of formation. The spine of the superior division in the abdominal feet shows an enlarged base like a spatula for the attachment of the muscles, which are much longer in the Heteronereid. He points out the increase of the cutaneous glands, especially the verticillate glands of the Heteronereid. The pigment at the moment of transformation undergoes marked changes. In the Heteronereid the cutaneous pigment becomes diffuse and disappears, except in the abdominal region, where brownish transverse lines occur. The peritoneal pigment undergoes resorption, except in the head and the basal segments of the tentacles and palpi. A brown line also occurs in the mid-abdominal region as a new development, for it is absent in the Nereid. The blood-vascular system shows corpuscles (nucleus and coat of protoplasm) in the Nereid, and the dorsal vessel has valves in pairs. These are not seen in the Heteronereid. He also found contractile vascular cæca in various regions in this species, *e.g.*, in the feet, and a dichotomous arrangement of vessels. These vessels undergo rapid development during the change of the foot. The muscular fibres become granular and indistinct in the Heteronereid. The proboscis presents remarkable variations in its paragnathi, the epigamous condition having small parallel groups arranged transversely. The maxillæ also, he states, show an increase in the posterior or muscular region in the Heteronereid, and generally seven or eight teeth are present.

Claparède shows a simple, long trumpet-like segmental organ. He says he did not find large examples of *N. Dumerilii* with sexual elements. They become Heteronereids. The sexual forms range from 15—35 mm., rarely the latter. The sexual elements in these develop as in other Nereids, and the ova are 0·41 mm. in diameter. There is no structural difference (externally) between male and female. In March he found a peculiar form in the tubes, violet in front and delicate green posteriorly, the latter colour being due to the development of the reproductive elements. Moreover, in the feet the developing heteronereid bristles can be seen. The eyes by-and-by enlarge. Peritoneal pigment is absorbed and other changes occur, as already noted. He truly calls this *epigamy*. Some, moreover, are hermaphrodite in the Nereid form, developing ova and sperms, as Mecznikow found at San Remo and Villefranche-sur-mer. The colour was violet or "rosy vinous." Moreover, no transformation was apparent in December, January, and February. This is probably the form found by Moquin-Tandon at Marseilles,[1] though the foot, as figured by Mecznikow, shows certain differences. So far as known it is still a question whether a specimen which has borne sexual elements as a Nereid can afterwards become a Heteronereid.

Racovitza (1896) describes the structure of the cephalic lobe (brain) in this species and compares it with that in certain other families. He finds three regions, viz., the sincipital connected with the eyes and antennæ, the region of the palps, and the nucal (posterior) connected with the ciliated nucal organs.

Möbius (1871), in the 'Pommerania' Expedition, observed that *Nereis zostericola*, *Heteronereis fucicola*, and *Nereilepas variabilis* were all forms of *Nereis Dumerilii*.

Wistinghausen[2] distinguishes three forms of this species: (1) In which reproduction

[1] 'Ann. Sc. Nat.,' 5e sér., t. xi, p. 134.

[2] 'Mitth. Zool. Stat. Neap.,' 1891.

is carried on without metamorphosis. (2) A small pelagic Heteronereid which is found at Naples in February and March. (3) A tubicolous Heteronereid form of large size which occurs in June and July. He gives a careful and well-illustrated account of the segmentation of the egg and the general development of this species up to the formation of the embryo. The species is stated also to be viviparous. A hermaphrodite form was found at La Hougue by Caullery and Mesnil [1] amidst *Lithothamnion*.

De St. Joseph [2] (1895) mentions that the homogomph bristles do not appear in the dorsal division except in the anterior part of the body; thus in a ripe female Nereid of eighty segments they appeared at the forty-first segment; at the thirtieth segment in a small example of 30 mm. and sixty segments. The last had a vibratile fossa on each side of the head between the posterior eyes and the base of the tentacles. He also notes that the intestine of an example contained *Doliocystis nereidis*, a gregarine.

The same author [3] more recently describes a new species (*Ceratonereis punctata*) from St. Raphael, the foot of which approaches that of *N. Dumerilii* somewhat closely.

6. Nereis diversicolor, *O. F. Müller*, 1771. Plate LII, figs. 4 and 4 *a*; Plate LX, figs. 11 and 11 *a*—head; Plate LXXII, figs. 5–5 *b*—feet; Plate LXXXI, figs. 5–5 *b*—bristles.

Specific Characters.—Head somewhat triangular and mottled with brownish pigment. Tentacles about a third the longitudinal diameter of the head. Palpi in life end in tapering extremities. Eyes of moderate size situated far back. Tentacular cirri of moderate length, the dorsal of the second pair being longest, and considerably exceeding the diameter of the body. Body 3—4 ins. in length, and of 120 bristled segments. Peristomial segment about twice the breadth of the succeeding. Tail terminating in two caudal cirri. General colour yellowish-brown, dusky anteriorly and greenish at the sides—from the feet, which are also vascular. Proboscis with two brownish maxillæ translucent at the base; teeth five to seven. Paragnathi are small. Dorsally, in extrusion, the maxillary division has a band (II) of small teeth on each side and one or two (I) in the middle line. Ventrally at the base of each jaw is a slightly curved belt of minute teeth (IV), narrower in front, broader behind, and directed nearly longitudinally. Between them is a broad belt (III) of small teeth, formed in some of a series of longitudinal rows of about three teeth, but in others they are less regular. The proximal segment has dorsally a group (VI) of small paragnathi (five to eight in number) on the eminence in front of each palpus. Ventrally a basal belt (VII and VIII) of minute teeth stretches from side to side, but with a gap between it and the dorsal groups. The first foot is distinguished by the three long, pointed conical lobes, the indistinct setigerous process, and the short cirri. The dorsal lobe increases to the tenth foot, and is also of considerable size at the thirty-seventh. Both setigerous lobes become prominent. The ventral lobe soon diminishes. Foot generally presents an uneven outline when viewed from above, the second and third lobes being

[1] 'Ann. d. Univ. de Lyon,' Bd. x, fasc. xxxix, 1898.
[2] 'Ann. Sc. Nat.,' 7e sér., t. xx, p. 214.
[3] Ibid., 9e sér., t. iii, p. 219, pl. iv, figs. 90—93, pl. v, figs. 94, 95.

anterior and the bristle-tuft posterior. In the inferior setigerous lobe the bristle-tuft emerges between the smaller anterior and the larger posterior process. Posteriorly the foot is less complex, and the ventral lobe diminishes. Bristles homogomph and heterogomph, the latter with a small club and a slight differentiation at the tip.

Synonyms.

1767. *Scolopendra marina,* Linnæus. Syst. Nat., ed. 12, t. i, pt. 2, p. 1064.
1776. *Nereis diversicolor,* O. F. Müller. Prod. Zool. Danica, p. 217, No. 2624.
1780. „ „ Fabricius. Fauna Grœnland., p. 291.
1791. „ *versicolor,* Linnæus. Syst. Nat., Gmelin, ed. 13, i, pt. 6, p. 3115.
1800. *Die bunte Nereide,* O. F. Müller. Naturges. einiger Würm-Arten., p. 104, Tab. vi, f. 1—6.
1806. *Nereis versicolor,* Turton's Linnæus, iv, p. 86.
1825. „ „ De Blainville. Dict. Sc. Nat., xxxiv, p. 436.
1827. „ „ Bruguière. Encycl. Méth., Vers. i, p. 134, Taf. 55, f. 1—6.
1828. „ „ De Blainville. Dict. Sc. Nat., lvii, p. 471.
1829. *Lycoris viridis* and *margaritacea,* Johnston. Zool. Journ., iv, pp. 419 and 420.
1834. „ *margaritacea,* idem. Loudon's Mag. Nat. Hist., vii, p. 230.
1839. *Nereis pelagica,* idem. Ann. Nat. Hist., iii, p. 290, pl. vi, f. 1.
1840. „ *brevimanus,* idem. Ibid., v, p. 170, f. 1.
„ „ *viridis,* idem. Ibid., v, p. 171, f. 2.
1843. „ *diversicolor,* Œrsted. Grœnl. Annul. Dorsibr., p. 24 (176).
„ „ „ idem. Annul. Danic. Consp., p. 23, f. 66, 68, 73.
„ „ „ idem. Kroyer's Nat. Tids., p. 118.
„ „ *Sarsii,* H. Rathke. Beiträge z. Fauna Norweg., p. 161, Tab. viii, f. 6—8.
1847. „ *depressa,* Frey and Leuckart. Beiträge z. Kenntniss wirbell. Thiere, p. 156, Taf. ii, f. 10, 12.
1851. „ *diversicolor,* Grube. Fam. Annel., pp. 49 and 126.
1853. „ *versicolor* (*fulgens*), Dalyell. Pow. Creat., ii, p. 153, pl. xxii, f. 6—8 (?).
1856. „ *diversicolor,* Max Schultze. Entwickl. Arenicola u. Kiemenwur., p. 214 (Halle), 4to.
„ „ *Sarsii,* De Quatrefages. Annel., i, p. 118.
1865. „ *diversicolor,* idem. Ibid., i, p. 508.
„ „ *brevimanus,* idem. Ibid., p. 510.
„ „ *brevimana,* Johnston. Cat. Worms Brit. Mus., pp. 147 and 341.
„ „ *viridis,* Carrington. Annel. Southport, p. 8 (183).
1867. *Hediste diversicolor,* Malmgren. Annul. Polych., p. 49, Tab. iv, f. 28.
1868. *Nereis* „ Ehlers. Börstenw., ii, p. 554, Taf. xxii, f. 5—9.
1870. „ „ Grube. Arch. f. Naturges., Bd. xxxvi, p. 311.
1873. „ „ Möbius. Jahresb. Comm. deutsch. Meere, 1873, p. 112; and 1875, p. 168.
1874. „ „ idem. Die Zweite deutsch. Norpol., p. 253.
„ „ „ Marenzeller. Sitz. d. k. Akad. Wiss., Wien, 1 Abth., p. 60.
„ *Hediste* „ Malm. Göteb. vet. o. vitt. Handl., xiv, p. 83.
„ „ „ McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 199.
1875. „ „ idem. Invert. and Fishes St. Andrews, p. 122.
1878. „ „ Lenz. Jahresb. Comm. deutsch. Meere, iv, Anhang., p. 12.
1879. „ „ Marenzeller. Op. cit. (Sudjap. Annel.), p. 122.
„ „ „ Tauber. Annul. Danic., p. 98.
1881. *Hediste* „ Leslie and Herdman. Proc. R. Phys. Soc. Edin., vol. vi, p. 274.
1883. *Nereis* „ Levinsen. Vidensk. Meddel. Foren. Kjöbenh., p. 236.

1885. *Nereis diversicolor,* Carus. Fauna Medit., p. 221.
1886. „ „ Schröder. Anat.-histol. Untersuch., 1886, 8vo. (Rathenow).
1889. „ „ Mendthal. Untersuch. Mollusk. u. Annel., iv, p. 8, pl. i, f. 1—9 (Königsberg).
1890. *Hediste* „ Malaquin. Annél. Boulon., p. 31.
„ *Nereis* „ Giard. Bull. Sc. Fr. et Belg., t. xxi, p. 275.
„ „ „ idem. Ibid., t. xxii, p. 78.
1891. „ (*Hediste*) *diversicolor,* Hornel. Trans. Biol. Soc. Liverp., vol. v, p. 241.
1893. „ *diversicolor,* Levinsen. Vidensk. Ud. 'Hauchs,' p. 329.
1902. „ „ McIntosh. Ann. Nat. Hist., ser. 7, vol. x, p. 256.
1904. „ „ Allen. Journ. M. B. A., N.S., vol. vii, p. 224.
1905. „ „ Graeffe. Arbeit. Zool. Stat. Triest, xv, p. 322.
1906. *Hediste* „ Bohn. Ann. Sc. Nat., 9e sér., t. iii, p. 86.
1908. *Nereis* „ Horst. Tijdschr. d. Nederl. Dierk. Vereen (2), Dl. xi, p. 139.

Habitat.—Abundant on various parts of the coast near high-water mark from the northern to the southern shores of Britain and Ireland. Thus, at St. Andrews, it frequents clayey ground near the shore-bridge in water that must frequently be brackish. At Perrelle Bay in Guernsey it inhabits holes which it apparently bores in the peat not far from high-water mark, the surface being studded with hundreds of holes of various sizes. It is also tossed on shore at St. Andrews after storms, which dislodge it from its tunnels. It occurs at Plymouth, where the density of the water is low (Allen), and Benham found it in brackish water at Bembridge, Isle of Wight.

A species very generally distributed on the shores of the North Sea, the Baltic, the Channel, and other European coasts, as well as in the Mediterranean. Japan (Marenzeller).

Head (Plate LX, fig. 11) somewhat triangular and mottled with brownish pigment. Anteriorly the apex of the triangle terminates in two short tentacles, which are about a third the longitudinal diameter of the head. The palpi end anteriorly in tapering extremities (in life). The eyes, which are of moderate size, are situated far back, the posterior pair being near that border of the head, the anterior a little in front and wider apart. The tentacular cirri are of moderate length, the longest, as usual, being the dorsal of the second pair, which in life is considerably longer than the diameter of the body. The basal segment (cirrophore) is tinted brownish, the cirri being translucent greenish.

Body of 120 bristled segments, and 3 to 4 ins. in length, thick and rounded anteriorly, thinner posteriorly, where it tapers to a delicate tail with two cirri. It is only slightly tapered anteriorly. The dorsal surface is rounded, the ventral flattened. The greatest breadth is about the eighth or tenth segment. The peristomial segment is about twice the breadth of the succeeding.

The general colour is yellowish brown, duskier anteriorly and greenish at the sides, from the feet. The dorsal blood-vessel makes a sinuous streak from the anterior to the posterior extremity, and the vascularity of the feet also gives a tone to the greenish sides. In some from Southport (Dr. Carrington) the colour ranged from dark green to orange. De St. Joseph describes French examples as having a longitudinal brown line on each side of the median dorsal vessel.

The proboscis (Plate LX, figs. 11 and 11 *a*) has two brownish maxillæ, translucent

at the base, and with five to seven teeth. The paragnathi are small. Dorsally, in extrusion, the proximal segment has a group of small paragnathi (VI), five to eight in number, in front of each palpus. The maxillary (distal) segment bears a band (II) of similar small teeth slanting obliquely outward on each side, and one or two in the middle line (I). Ventrally (Plate LX, fig. 11 *a*) a belt of minute teeth (VII and VIII) stretches from side to side of the basal division, but with a gap between it and the dorsal groups. At the base of each jaw is a slightly curved belt (IV) of similar minute teeth, narrower in front, broader behind, and directed nearly longitudinally. Between them is a broad belt (III) of small teeth, formed in some of a series of longitudinal rows of about three teeth, in others less regularly grouped.

Fragments of peat and Algæ occurred in the alimentary canal of one from Lochmaddy.

The first foot (Plate LXXII, fig. 5) is distinguished by the three long, acutely conical lobes. Dorsally is a short cirrus, not reaching the tip of the dorsal lobe, which forms in outline an isosceles triangle. There is no trace of a dorsal setigerous lobe. The next lobe is fused at its base with the ventral lobe, pushing the inferior setigerous lobe to the front. Both form acute cones. The ventral cirrus is short and filiform. Dorsally the setigerous process bears bristles with long tapering tips, and ventrally those with shorter tips, both furnished with well-marked spines. The shorter bristles have a blunt hook at the tip.

At the tenth foot a view from above shows that the second and third lobes are anterior and the superior bristle-tuft posterior. The inferior setigerous lobe has its larger horn posterior, the bristle-tuft being between it and the smaller anterior horn. The foot thus presents an uneven outline when viewed vertically. Laterally the foot shows a greatly developed dorsal lamella of a triangular outline (Plate LXXII, fig. 5 *a*), with the short cirrus at its base. The two lobes beneath seem to be associated with the superior setigerous lobe. Both project on the anterior face of the foot, the bristles being behind. The bifid condition of the inferior setigerous lobe diverges from the foregoing in so far as the one (smaller) lobe is anterior and the larger posterior, the bristle-tuft passing out close to the former. The ventral lobe is triangular or lanceolate in outline, and the ventral cirrus reaches only a little beyond its middle. The bristles of the dorsal lobe all have long, tapering, and finely spinous tips (Plate LXXXI, fig. 5). The upper bristles of the inferior setigerous lobe are similar in structure, and so with the upper bristles of the lower tuft, whilst the lower bristles have shorter tips, with spinous edges and a hook at the tip, one of those with a longer tip being shown in Plate LXXXI, fig. 5 *a*, and one with a shorter tip in the same plate, fig. 5 *b*.

The thirty-seventh foot (Plate LXXII, fig. 5 *b*) presents a greater elongation and a more pointed condition of the superior lobe, an increase in size of the third lobe, a fusion of the elements at the tip of the inferior setigerous lobe, so that the outline is simplified, and a considerable diminution of the ventral lobe—formerly so conspicuous. The bristles follow the same arrangement. The forms with the short tips (inferior edge of the ventral series) show a differentiation of the club at the tip (Plate LXXXI, fig. 5 *b*).

The posterior feet (*e.g.*, sixty-third) diminish much in size, and there is a fusion of the superior setigerous lobe with that below it. The inferior setigerous lobe is very

prominent as a single process. The ventral lobe is minute, and the ventral cirrus is a small filiform organ behind the ventral edge of the foot.

Habits.—As the early authors observed, this Nereid burrows in the clayey mud often in estuaries where the water must sometimes be brackish. Moreover, the entrance of sewage into the water does not seem harmful to it, and the dark mud is often odoriferous, yet there it lives and breeds. Horst [1] gives some interesting notes and references on this subject, quoting especially the experiments of Ferronière and Metzger.

Mr. Goodrich [2] gives an account of a "new dorsal organ in every segment," except a few after the first and before the last; and consisting of a pair of large ciliated patches of cœlomic epithelium present in most species of the Nereidæ. He considers it a genital duct not fully developed. He also notes that the nephridium consists of a compact mass perforated by a convoluted canal. The nephrostome has long ciliated processes communicating with the anterior by a short duct on the ventral surface (nephridiopore).

Reproduction.—Various statements have been made about the reproduction of this species. Thus Max Schultze [3] refers to the occurrence of the young in the body-cavity, having apparently considered Koch's statements in regard to *Marphysa sanguinea* as correct. He describes them as pea-shaped, reddish-yellow embryos, with mouth, rudimentary digestive system, two eyes, and small pits or furrows ("Löchern") under the feet.

Cuvier and Grube, again, thought *Arenicola* was hermaphrodite, and Rathke placed *Amphitrite* in the same category, though each might be more or less male or female. An interesting *résumé* of the views of the period is given by Frey and Leuckart.[4] Claparède and Mecznikow [5] give an account of *Cirratulus chrysoderma*, Clpde., an adult of which presented at each side in the median region of the body ovoid sacs, which were at first thought to be parasitic Crustacea. They proved, however, to be young Cirratulids, one figured by the authors showing an elongated body, two eyes, two pairs of filiform branchiæ, with several bristles and hook-bearing segments behind, and a fairly complete alimentary apparatus. A. Krohn,[6] again, describes from Nice a viviparous *Syllis* (*S. vivipara*) allied to *S. Armandi*, only the new form has simple tips to the terminal pieces of the bristles. The enclosed young form has twenty-three segments, and is like the adult.

In F. M. Balfour's 'Embryology' [7] it is stated that "a few forms (*e.g.*, *Eunice sanguinea*, *Syllis vivipara*, and *Nereis diversicolor*) are viviparous." Considerable reliance in more recent times has been placed on the observations of Mendthal on the supposed hermaphroditism of *Nereis diversicolor*. This author seems to have been attracted to the subject by the previous work of Schröder,[8] but beyond the general and incorrect view

[1] 'Tijdschr. d. Nederl. Dierk. Vereen' (2), Dl. xi, p. 142.
[2] 'Quart. Journ. Micr. Sci.,' April, 1893.
[3] 'Entwickelung *Arenicola piscatorum*, etc.,' p. 214 (Halle, 1856).
[4] 'Beitr. z. Kenntniss wirb. Thiere,' p. 82 (1847).
[5] 'Zeitschr. f. wiss. Zool.,' Bd. xix, p. 192, sep. abdr., p. 30, Taf. xiv, f. 4.
[6] 'Arch. f. Naturges.,' Bd. xxxv, p. 197, 1869.
[7] Vol. i, p. 319.
[8] 'Anat.-histol. Untersuch. von *Nereis diversicolor*,' O. F. M., Rathenow, 1886, p. 35.

that in most Polychæts the fertilization and development of the eggs occurs in the interior of the mother, there seems to be very slender foundation in fact. It is true Schröder states that in sections he has found the morula-stage of *N. diversicolor* in the body-cavity, but the complex condition of things in this species before, at, and after reproduction might well lead to misinterpretation. Schröder, at any rate, could not find the later stages in April and May. Meudthal described the species from the Bay of Pillau as carrying both eggs and testes in June, and he was the more inclined to believe in its hermaphroditism since Schröder met with only three males out of forty-eight examples. He places and figures the testes in the dorsal region as pear- or flask-shaped masses to the exterior of the dorsal longitudinal muscles. The supposed testes, therefore, occupy the same position as the outer limb of Dr. Goodrich's dorsal organ, and it may be that the cilia were a source of misapprehension. On the other hand, he describes the ova as developing at the bases of the feet, the figure representing them in the position of the segmental organ.

De St. Joseph, however, could not corroborate the foregoing observations. Gravier, on the other hand, considers that hermaphroditism and viviparity may exceptionally exist in this form, and in the 'Cambridge Natural History' it is stated that viviparity is characteristic of it, whilst Goodrich[1] quotes it as a viviparous hermaphrodite along with "*Salmacina Dysteri* and *Pomatocerus triqueter*."

The annelid is very common on many parts of the British shores, burrowing in clay, sand, mud, peat, and similar media, and at St. Andrews it abounds at the upper end of the harbour amidst muddy clay on the sides of the Kinness Burn which enters there. Careful observations were carried out lately to test the condition as regards reproduction; yet though both hermaphroditism and viviparity have been discountenanced, it has not been possible to find the worm either discharging from its tunnel in the mud its eggs and sperms or becoming pelagic at maturity and thus dispersing the sexual elements. So far as can be observed, the former, perhaps, seems to be the more likely, though no certainty exists on this head.

In the middle of October the majority of the examples—both large and small—are females with fairly developed ova, which are almost visible to the naked eye and easily under a lens. In these the vascularity of the feet has slightly increased, but no change in the lobes of the feet or in the bristles has occurred. Amongst the ova in the cœlomic space are numerous pale granular cells, apparently modified perivisceral corpuscles. Very few males are obtained at this time, and these for the most part are undeveloped.

In November comparatively few ova are attached to the ventral plexuses, most being free in the perivisceral space. On the other hand, the vascular plexuses in the region of the ciliated organ are laden with dense groups of rather coarsely granular cells, sometimes in lobular masses, and it is considered that these pale cells are associated with the growth and maturation of the ova in the cœlomic space. The ova increased considerably in size towards the end of the month.

In transverse section[2] the body of the annelid at this time differs little from the type

[1] 'Journ. Linn. Soc.,' vol. xxviii, p. 107.

[2] I am indebted to Dr. Tosh, Assistant Professor, for valued aid in making these sections and in other respects.

except in the presence of ova, which appear most abundantly, in the sections, at the bases of the feet and extending into their lobes. The number in the cœlom is not large, many, in all probability, having fallen out. The dorsal and ventral longitudinal muscles show little change, the pennate fold of the latter being well developed. The oblique muscles pass at each side slightly below the nerve-cord to be attached to the basement-membrane; and at least three neural canals are present, the larger lateral having a coagulable fluid internally, and each runs along the outer border of the nerve-trunk between the pairs of ganglia. The median or dorsal canal, again, appears to have a separate strand in the interganglionic region, and when it reaches the ganglia it splits into two trunks in certain sections. The muscles of the bases of the feet and of the bristles are also strong. The wall of the alimentary canal appears to be of normal thickness.

The annelids remained very much in the same condition during December, the great majority of those examined being females, so much so that it was at first considered probable that, as authors had stated, a complex sexual condition existed (*e.g.*, alternate development of the reproductive elements); but as a few males were still met with and no trace of an intermediate stage occurred, such complexity could not be proved. This month the only difference in the sections of the females is the increase in the size of the ova, the abundance of the cœlomic corpuscles, and the distension of the body-cavity and the bases of the feet, so that the muscles of the wall are stretched. The vascularity of the outer surface of the gut also appears to be increased. The segmental organs show no feature of note. In the males the perivisceral cavity and the bases of the feet contain dense masses of translucent granular cells, the large nuclei of which stain deeply with eosine.

The great increase of the large granular cells in the cœlomic cavity in January is a feature of moment, especially in those females in which the ova are small. The enormous masses of these cells distend the bodies of the females and they probably increase by division, each being filled with spherules. In glancing at the living annelids a pale, or greyish-green hue characterizes the posterior region of the body in the females; whilst the anterior segments have their vascularity increased, the dorsal vessel of the foot and its branches especially being distinct. When the posterior region is punctured, the masses of ova have a pale greenish colour as in the previous months, and are similarly unfertilized. As many have discharged ova, it would appear that fertilization is external as in allied forms.

The sexes are not always distinguished by colour, both males and females being greenish or dull yellowish, though the males are often paler. No change in eyes, feet, or bristles is apparent. In many an opaque, dull whitish condition occurs in the anterior feet, which are filled with the large granular perivisceral corpuscles. Moreover, almost all have a touch of white at the base of the dorsal cirrus—from one end of the body to the other, a similar touch occurring at the tip of the cirrophore of each tentacular cirrus.

Mendthal[1] figures two examples, one of the general brownish-orange hue of the

[1] 'Untersuch. u. d. Mollusken u. Anneliden des frischen Haffs,' p. 9, Taf. figs. 1 and 2 (Königsberg, 1889).

ordinary type, and the other of this colour in the anterior fourth, whilst the rest is of a grass-green tint. He considers that the latter (green) colour is due to a diet of green Algæ, a condition which is not in accordance with the observations at St. Andrews, where the greenish hue appeared to be the result of the presence of masses of more or less ripe ova. There is no reason, however, why a diet of *Ulva* or other green Alga should not tint the digestive canal green.

In the male the sperm-cells fill the various cavities even to the bases of the dorsal cirri throughout January, but though the body-wall is frequently distended, no degeneration of the muscular bands can be observed. In the females the size and abundance of the ova in particular examples vary, but, as a rule, the granular ova with a slightly stained nucleus and a more deeply stained nucleolus are more or less advanced towards maturity. Occasionally an example with few and small ova appears. In some of these the muscular walls of the body are contracted, and very few ova, and these of small size, occur in the perivisceral space. More frequently they are found in the feet. Masses of ovigerous tissue are attached to the vessels near the bases of the latter; and cellular masses (it may be parts of the dorsal organ) with boldly stained nuclei pass upward at the bases of the feet within, as well as without, the lateral lobe of the dorsal longitudinal muscles, and in specimens having a considerable number of large ova similar cells pass into all the spaces of the feet. These loose cœlomic masses probably represent the cells alluded to in the living forms.

In February the increase in size and the division of the sperm-cells form the most noteworthy feature, but no free sperms are seen. In the other sex the ova in many have considerably increased in size, and from the appearance of the annelids a large number of ova must have been discharged.

Signs of rapid division of the sperm-cells characterize many males in the middle of March, and towards the end of the month the perivisceral cavity forms a vast reservoir for the male elements. The body-walls are stretched, the muscular layers diminished, and the alimentary canal collapsed. The tubes of the segmental organ have also enlarged, so that sperms could readily find issue by the segmental papilla. Though the nuclei of the walls of the organ and its tubes are everywhere distinct, no trace of sperms was at any time found within it, so that they probably escape by rupture of the body-wall, as in allied forms.

The ova in the various examples throughout March appear to attain full size and maturity, and they are remarkably large, viz., about ·1524 mm., and they are probably shed by rupture of the body-wall, the vast numbers set free, even from a limited area, affording an indication of the almost illimitable resources of nature in the sea. Whether the sexes discharge their elements *in situ* or by a terminal pelagic stage could not be ascertained. None were captured in the tow-nets dragged, by day and by night, up stream at ebb-tide, and no indication of any change in the structure of the feet, bristles, or eyes, and no shrivelling of the posterior region of the body as in the very interesting *Ceratocephalus Osawai* of Akira Izuka,[1] common in the estuary of the Sumida River in Tokyo, occurred. If one may hazard a conjecture, it is probable that the sperms and ova are discharged on the sites inhabited by the annelids, and the larvæ by-and-by carried

[1] 'Journ. Coll. Sc. Univ. Tokyo,' vol. xvii, art. ii (1902).

seawards. There is no doubt, however, that, without change in the condition of the feet and bristles, the species is an apt swimmer, progressing through the water swiftly in graceful screw-coils.

Towards the end of May (29th) and for some time previously signs of degeneration appear in certain ova, as if they were in process of absorption. These ova are smaller, minutely granular, and with larger oil-globules. The larger ova have lost the germinal vesicle and spot, and transmit light more readily than formerly. Nothing is seen to suggest the view that certain ova are undergoing development, for, when kept in vessels both of sea-water and fresh water, they are rapidly disintegrated.

Some females at this date have shed all their ova, and are of a pale brownish-yellow colour, occasionally with a minute dusting of yellow grains along the dorsum.

Having failed to secure the early larvæ by any of the methods alluded to, masses of the clayey mud with the adults *in situ* were brought from the banks of the Kinness

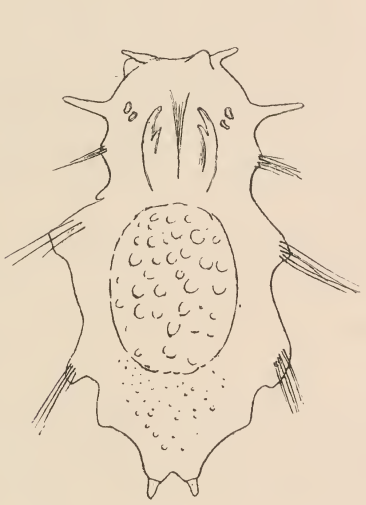


Fig. 71.—Post-larval *Nereis diversicolor* with three pairs of bristles.

Fig. 72.—Maxilla of larval *N. diversicolor*.

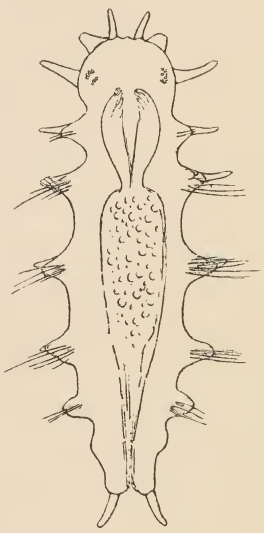


Fig. 73.—Post-larval *N. diversicolor* with five pairs of bristled feet.

Burn near the harbour towards the end of May, and a strict scrutiny was made of the tubes and the mud lining them. Numerous post-larval forms were thus obtained, but no trace of trochophores or other early stages. Whether these stages had been passed in such an environment before the examination, or whether the later larvæ to be subsequently described had settled in the mud of the tubes after a pelagic stage, is yet undetermined.

The youngest stage observed has three bristled segments (Fig. 71), a head with two short palpi, and two short frontal tentacles. The eyes are imperfectly differentiated, consisting of an irregular group of black pigment-granules. A tentacular cirrus occurs on each side opposite the eyes. The three feet are nearly alike, each with a bristle-tuft and a small dorsal cirrus, or the first is rudimentary. A minute caudal cirrus is at each side of the posterior end. Between the last foot and the pygidium is a projection, indicating a segment. The proboscis has a pair of jaws each with three long teeth, including the anterior fang (Fig. 72). The opaque part of the gut extends over the last two bristled segments. The minute bristles already present the typical

structure of camerated shaft and homogomph articulation of the end of the shaft, and are in two bundles in each foot.

No younger form has yet been found amongst the mud or the adults, so that it is probable that they settle down at this stage. Moreover, no pelagic larvæ appeared in the vessels; but as the post-larval forms with three bristled segments occurred in the mud of the tubes of the adult, it would appear that all do not wander. Yet pelagic Nereids with six bristled segments occur in the tow-nets of the period, but whether of this or other species is yet uncertain.

When the post-larval form has four bristled segments the head has two eyes on each side, placed close together and posteriorly, a pair of short frontal tentacles, short palpi which present no distal articulation, a pair of tentacular cirri, and two short anal cirri. Behind the head, which bears the tentacular cirri, is a region with only bristles on each side; a foot with a large bristle-tuft and a minute dorsal cirrus follows, and then a second foot of similar structure. A rudimentary foot comes next, with a bristle-tuft on one side. A rudimentary ventral cirrus occurs on each foot. A pair of minute jaws having two teeth behind the anterior fang is found in the proboscis. Vast swarms of Infusoria (like monads) frequent the moist and odoriferous mud in which the young Nereids live.

The post-larval form of the 28th May (Fig. 73) has a head with two comparatively large frontal tentacles and two stumpy palpi with very short terminal segments that only occasionally are visible, two pairs of tentacular cirri, the last with a spine in the dorsal, five pairs of distinctly bristled feet, with more evident dorsal and ventral cirri and slightly brownish spines, besides two rudimentary ones behind and a large pygidium with two caudal cirri. The cirrus of the first bristled segment is elongating, but the bristles are shorter than in the succeeding foot. The mouth is a wide aperture, followed by the somewhat ovoid proboscis, which is armed with two translucent jaws having three prominent teeth which are proportionately longer than in the adult. The proboscis is narrowed posteriorly and joins a large opaque, yellowish, glandular region, broad and truncated in front and diminishing posteriorly and terminating in the pale rectal part of the gut and its dorsal anus. The opaque glandular region stretches from the space between the second and third feet to the last bristled foot, and shows the groups of oily granules so characteristic of the glands on the walls of the alimentary canal. Two slightly opaque ovoid glandular bodies, the segmental organs, lie behind the first complete foot, just in front of the opaque region of the gut, and active ciliary action is occasionally noticed in them.

In the post-larval form with six bristled feet the eyes are better defined, and the palpi, frontal tentacles, and tentacular cirri are larger. The dorsal cirrus of the first bristled segment is the longest in the animal, but there is no spine. The spines are darker, the posterior end remains bifid, and three teeth occur behind the anterior fang in each jaw.

When seven bristled feet are present the caudal cirri are considerably longer, the last foot (seventh) having a few short bristles, a short dorsal cirrus, two short spines, and a minute rudiment of a ventral cirrus. Behind is an indication of the eighth foot as a lateral projection, with a minute papilla representing the dorsal cirrus. Internally is the tip of a minute spine, but no bristles. The ventral of the first pair of tentacular cirri

(opposite the eyes) is a short subulate process; that of the next segment is indistinct, though, with the exception of the caudal cirri, the dorsal is the longest of the series. The bristles of this segment are always short and in contrast with the next segment, which shows the segmental organs immediately behind. Opacities in the corresponding parts of the following feet indicate the early development of these organs throughout. Traces of a fourth tooth behind the great anterior fang of the maxillæ are visible. This description might also apply to a post-larval form with eight pairs of bristled feet (Fig. 74), the latest stage observed towards the end of May.

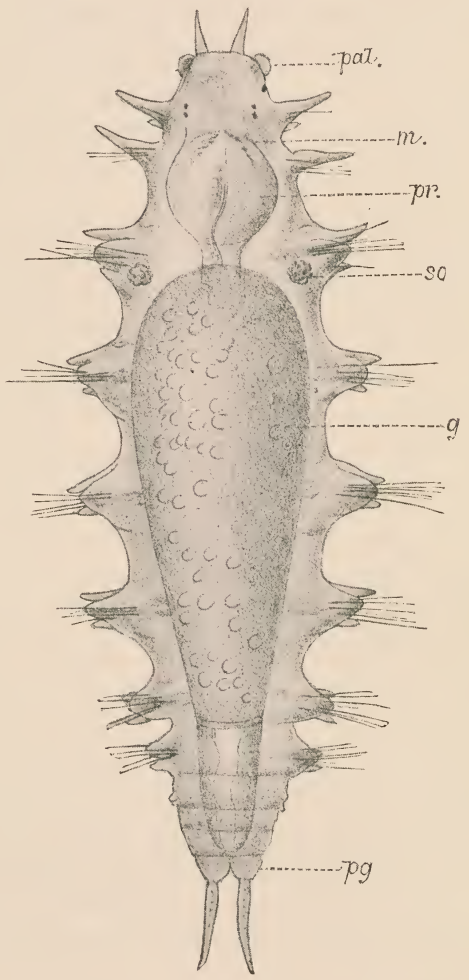


Fig. 74.—Young *N. diversicolor* with eight pairs of bristled feet and four eyes. *g*. Glands of alimentary canal. *m*. Maxillæ. *pal*. Palpi. *pg*. Pygidium. *pr*. Proboscis. *so*. Segmental organ ?.

If the young Nereids of the foregoing stages are left in the vessels beside the adults the larger examples rapidly disappear. They are probably devoured by the adults, only the minute stages escaping capture, and in all likelihood they, too, would by-and-by be found out and captured; yet, as in the fishes, these checks have little influence on the permanent abundance of the species.

On the 17th July the young forms are found on the same sites, but considerable progress has been made in development. The head in outline nearly resembles that of the adult, and is marked by whitish pigment in the younger, brownish in the older, in front of

the eyes, which are definitely formed on each side, the anterior pair being somewhat larger and furnished with lenses. The frontal tentacles and the palpi are well formed and show numerous fine palpocils, the mobility of the distal segment of the palpi being noteworthy. The two pairs of tentacular cirri are now much longer, the dorsal stretching outward like fine hairs as the animal pushes its snout forward. They retain the proportions to each other as in the adult, though they have not yet reached full development in any case. The ventral of each is considerably shorter than the dorsal, but projects clearly on each side, the first rather longer and thicker at the base than the frontal tentacles. The body is now elongated, having from sixteen to twenty bristled feet, and is marked along the centre by a yellowish or brownish streak, often slightly moniliform or zigzag from the intestinal contents, and a whitish dot is observed in some at the bases of the feet. The massive and somewhat ovoid proboscis has six teeth behind the great anterior fang, and the narrow part of the canal behind it is usually firmly contracted (and empty). The first part of the gut behind the post-proboscidian narrow region is the largest, and for some distance it is not marked by lateral constrictions, as in the succeeding portion. Most of the feet anteriorly present a condition approaching that of the adult, though the dorsal cirrus is shorter. Only the last two feet are devoid of bristles externally. The caudal cirri are considerably longer. The circulation of the red blood in the dorsal and ventral trunks is now evident. The segmental organs extend backward to the posterior feet, though not quite to the tail.

So far as observed at St. Andrews, therefore, there is no foundation for the statement that the Scotch representatives are hermaphrodite, and still less that they are viviparous, as mentioned by Max Schultze, by the 'Cambridge Natural History,' and by Gravier. Max Schultze[1] gives a circumstantial account of finding female examples in April at Greifswald with ciliated eggs and pear-shaped larvæ in the body-cavity, and he figures two of the latter, hundreds of which occurred in the cavities at the bases of the feet. His figures, however, give rise to doubt as to the nature of the ciliated forms, which have the narrow end of the pear anteriorly with the two eyes at some distance behind it. In one, indeed, the mouth is indicated behind the eyes as a small radiated disk. The posterior end of the larva is broad and rounded. In the light of the condition at St. Andrews doubt arises as to correctness of the interpretation, more especially in view of the structure of the larva; but it is right to give a margin for possible variations in regard to internal fertilization under certain circumstances. Yet it seems unlikely, and De St. Joseph[2] is of the same opinion.

The foregoing interpretation as to the mode of reproduction would seem to be most in accordance with observation, since on the 28th May masses of clayey mud brought from the habitat of the species and with the annelids *in situ* showed many free ova amongst the mud coating the walls of the tube, and, further, various post-larval examples.

In connection with the reproduction of *Nereis* interesting experiments have been carried out by Loeb and Fischer, in which they found that the unfertilized eggs of *Nereis limbata* developed into swimming larvæ by keeping them for some time in sea-water

[1] 'Amer. Journ. Physiol.,' vol. ix, p. 100, 1903.
[2] 'Ann. Sc. Nat.,' 8e sér., t. v, p. 298, 1898.

concentrated by the addition of potassium chloride, and then returning them to ordinary sea-water.

In the British Museum specimens of this species from Bexhill and various parts of the southern coast are labelled *Nereis fimbriata*, whilst others which bear the title *N. diversicolor* pertain to *N. cultrifera*, *N. pelagica*, and *Alitta virens*.

The *Nereis fulgens* (*versicolor*) of Dalyell has been placed under this head with some doubt. The figure might pass for the reddish-brown female of *N. pelagica*.

This species is largely used for bait in the Channel Islands. Mr. Punnett also found that at Gosport it was frequently employed for the capture of pollack.

In his original account of this Nereid, O. F. Müller (1800) enters into a disquisition as to the history of this "sea scolopendra," as such forms were termed by Aristotle, and its connection with the "Rödat."

The *Nereis Beaucondrayi* of Aud. & Edw. and Keferstein [1] seems to come near this form.

Max Schultze in 1856 refers to the occurrence of the young in the body-cavity of the mother, but so far as observations in this country go this has not been corroborated. He seems to have considered that Koch's statements in regard to *Marphysa sanguinea* were literally true.

Malmgren (1867) constituted the genus *Hediste* for this species, founding the distinction chiefly on the trifid nature of the superior division of the foot, but it seems unnecessary to multiply genera on this basis.

Schröder [2] (1886) gave a general account of this species structurally and otherwise, and added a note in regard to its reproduction. His observations were made at Kiel.

Mendthal (1889) thought the species was hermaphrodite, the ova being developed at the bases of the feet, whilst the sperms occurred in the dorsal region external to the longitudinal muscles. This has not been corroborated at St. Andrews. Like Schröder he also found Gregarinæ in the gut, and the early stages in the muscles. He also refers to the respiratory function of the lobes of the feet.

An interesting account of the "swarming" and development of *Nereis japonica*,[3] n. sp., is given by Akira Izuka, who, while admitting close resemblances between it and *Nereis diversicolor*, bases his distinction on the fact that the paragnathi in the Japanese form in VII and VIII are arranged in a continuous row, whilst in *N. diversicolor* they are in the form of three or four irregular rows, that the falcate bristles of the former are larger than those of the latter, that the eyes have lenses in the Japanese, and that the breeding habits of the latter differ from those of *Nereis diversicolor*. After a perusal of the description in all its details, however, the very close resemblance of the two forms is apparent, and though the "swarming" of *N. diversicolor* has not yet been observed in Scottish waters, that and other slight divergences may be due to environment, and especially to temperature and food. It has to be remembered that some forms, *e. g.*, *Eunereis longissima*, may or may not have paragnathi, so that future investigations may show that changes of the nature indicated by Izuka may not have the importance claimed for them.

[1] 'Zeitschr. f. wiss. Zool.,' Bd. xii, 1862, p. 94, Taf. viii, figs. 1—6, and 12, 1862.

[2] 'Anat. histol. Untersuch. von *N. diversicolor*, Rathenow,' 1886, 1 plate.

[3] 'Annot. Zool. Japon.,' vol. vi, part 4, 1908.

7. Nereis longissima, *Johnston*, 1840. Plate LXI, figs. 1–1 *b*—head; Plate LXXIII, figs. 1–1 *d*—feet; Plate LXXXI, figs. 6 and 6 *a*—bristles.

Specific Characters.—Head small, broader posteriorly, and tapering to a narrow snout, bearing two tentacles of moderate length. Eyes obscure, in some preparations only indicated by the duskiness of the thick cuticle in the ordinary position. Tentacular cirri short. Body elongated, 10 ins. to a foot or more in length. The peristomium is considerably wider than the next segment. Colour slate-blue in front and finely iridescent. Ventrally the surface is lilac. Proboscis dark bluish; maxillæ dark brown, seven teeth. Proximal and distal regions in extrusion mottled, and marked by grooves into areas. In some no paragnathi occur, but in an epitokous female the basal segment dorsally has on the usual eminence on each side four small brownish-black paragnathi (VI). Moreover, on the ventral aspect of the distal section an irregular dark brownish patch (IV) appears on each side near the base of the jaws. The first foot has moderately developed dorsal and ventral cirri, only a little shorter than the elongated and pointed dorsal and ventral lobes. The intermediate setigerous lobe forms a small papilla. The feet generally are characterized by three long lanceolate and pointed lobes, a trifid inferior setigerous lobe, and the cirri are short. The bristles consist chiefly of those with long, slender, tapering tips, but beneath the upper series (above the spine) in the inferior setigerous process is a group of those with short falcate tips (heterogomph), longer, however, than those of the previous species.

In the epitokous form great lobes are developed (*e.g.*, sixty-seventh foot) dorsally, on the posterior surface of the inferior setigerous lobe, and at the ventral cirrus, whilst all the other lobes are expanded. Swimming bristles are present. This condition continues till near the tip of the tail.

Synonyms.

Atokous Form.

1800. *Die faserige Nereide,* O. F. Müller. Naturges. einiger Wurm-Arten., p. 144, Tab. viii, f. 1—3.
1825. *Nereis longissima* (Sav.), De Blainville. Dict. Sc. Nat., xxxiv, p. 443.
1850. ,, *regia,* De Quatrefages. Ann. Sc. Nat., 3e sér., Zool., t. xiv, p. 339.
1865. ,, ,, idem. Annel., i, p. 511.
,, ,, *edenticulata,* idem. Ibid., p. 538, pl. vii, f. 1 and 2.
,, ,, *longissima,* idem. Ibid., p. 581.
1869. ,, ,, Grube. Abh. Schl. Gesell., 1868–9, p. 100.
1874. ,, ,, idem. Jahresb. Schl. Gesell., 1873, p. 69.
,, *Eunereis* ,, Malm. Göteb. vet. o. vitt. Handl., xiv, p. 84.
1876. *Typhlonereis gracilis,* Hansen (?). Nyt Mag. f. Naturvid., xxiv, 1 Hefte, p. 4, Tab. iii, f. 6—10.
1879. *Nereis longissima,* Tauber. Annul. Danic., p. 100.
1883. ,, ,, Levinsen. Vidensk. Meddel. Foren. Kjöbenh., p. 233.
1890. *Ceratonereis longissima,* Malaquin. Annél. Boulon., p. 28.
1898. *Eunereis* ,, De St. Joseph. Ann. Sc. Nat., 8e sér., t. v, p. 304, pl. xvi, f. 88—100, and pl. xvii, f. 101.
1902. ,, ,, McIntosh. Ann. Nat. Hist., ser. 7, vol. x, p. 256.
1904. ,, ,, Allen. Journ. M. B. A., n.s., vol. vii, p. 224.

Epitokous Form.

1840. *Nereis longissima,* Johnston. Ann. Nat. Hist., vol. v, p. 178, f. 9.
1843. *Heteronereis paradoxa,* Œrsted. Grönl. Annul. Dorsib., p. 177, f. 50, 63, 64, 66.
1844. *Nereis longissima,* Thompson. Rep. Brit. Assoc., 1843, p. 273.
1851. „ „ Grube. Fam. Annel., p. 50.
1865. *Heteronereis longissima,* Johnston. Cat. Worms Brit. Mus., p. 164.
„ *Eunereis* „ Malmgren. Nord. Hafs-Annul., p. 183.
1867. *Nereis* „ idem. Annul. Polych., p. 57, Tab. v, f. 32.
„ „ „ Parfitt. Trans. Devon Assoc., ii, p. 23 (sep. copy).
1868. „ „ Ehlers. Börstenw., ii, p. 525.
1874. *Eunereis* „ McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 199.
1875. „ „ idem. Invert. and Fishes St. Andrews, p. 122.

Habitat.—Tossed on shore after storms in March and October, St. Andrews (E. M.); Peterhead, advanced epitokous female (Mr. John Bain, Fishery Officer); Montrose Bay, epitokous forms (Dr. Howden). A small example in the stomach of a flounder at St. Andrews (E. M.). Epitokous forms with the lamellæ but slightly developed occur on the West Sands, St. Andrews, at the end of March (E. M.).

Extends to Ireland (Johnston).

St. Magnus Bay, 80—100 fathoms (J. G. Jeffreys); rather small example.

Ranges to the Mediterranean ('Porcupine,' and Claparède, if his *Nereis* (*Ceratonereis*) *guttata* refers to the same form). Epitokous form, Greenland (Œrsted). North Sea.

Head (atokous) (Plate LXI, fig. 1) somewhat small, broader posteriorly, and tapering anteriorly to a narrow snout, bearing two tentacles of moderate length. The eyes are in some preparations obscure, only indicated by a duskiness of the thick cuticle. They occupy the lateral regions of the broad part of the head, the anterior pair being somewhat wider apart than the posterior. They are best seen in the epitokous form as slightly elevated pale areas with what appears to be a cuticular lens in the centre. The tentacular cirri are short.

Body much elongated—10 ins. to a foot or more—and having seventy to two hundred and forty segments, gently narrowed anteriorly so as to give a character to the region, and again diminishing to a slender tail. It is firm and resistant anteriorly, flatter posteriorly, especially in the epitokous female. In the latter the dorsum is of a slate-blue colour, finely iridescent, the corrugated regions at the bases of the feet having a greenish sheen. The large lamellæ of the feet are pinkish from the blood-vessels. Ventrally the body is lilac in front, then greenish-blue. The first segment (peristomium) is considerably wider than the succeeding. The body terminates posteriorly in two long cirri.

The proboscis (Plate LXI, figs. 1 *a* and 1 *b*) is of a blackish-blue colour, and probably increases the dusky appearance of the anterior region when retracted. The maxillæ are deep brown, with seven teeth (epitokous female).[1] The proximal and distal (maxillary) regions, in extrusion, are mottled and marked by grooves into areas. In some no paragnathi are present, but in an epitokous female the basal segment dorsally has in front of each palpus, on the usual eminence, a group (VI) of four small brownish-black

[1] Ehlers gives seven to ten teeth.

paragnathi. Moreover, on the ventral aspect of the maxillary section, an irregular dark brownish patch (IV) occurs on each side near the base of the jaws. That on the left is the larger, and is distinctly horny (Plate LXI, fig. 1 *b*).

The first foot (atokous form, Plate LXXIII, fig. 1) has dorsally a large cirrus which extends considerably beyond the tip of the dorsal lobe. The latter forms a long and somewhat narrow cone. The setigerous lobe beneath appears as a short papilla in lateral view. The ventral lobe has a similar outline to the dorsal, though its tip is less acute, and the inferior line longer. The ventral cirrus is large and long, its tip reaching that of the adjoining lobe. The bristles are apparently all furnished with tapering tips.

At the third foot another lobe appears, probably above that which was dorsal in the first foot. At the tenth (Plate LXXIII, fig. 1 *a*) the diminution of the dorsal and ventral cirri, the presence of a superior setigerous lobe, and the increase in the inferior setigerous lobe are the chief features. The dorsal lobe is somewhat smaller than the next, the ventral being considerably shorter than these. The bristles (Plate LXXXI, fig. 6) of the superior setigerous lobe are of one kind with long, tapering, spinous tips, but, in the typical foot, amongst those of the inferior setigerous process, are some falcate bristles (Plate LXXXI, fig. 6 *a*). These occur as rather stout bristles near the spine, and also more slender forms at the ventral edge of the series. The falcate forms are not readily seen in a cursory glance, and had escaped the notice of Malmgren—unless the northern form differs from the British in this respect.

Little change in the general form of the foot in the atokous condition takes place posteriorly (to the one hundredth at least) except the increase of the gap between the second lamella and the inferior setigerous lobe (Plate LXXIII, fig. 1 *d*), the diminution of the dorsal and ventral cirri, and to some extent that of the ventral lobe. Toward the tip of the tail, however, the cirri again become longer, and the inferior setigerous process increases in size, whilst the ventral lobe is considerably less.

The bristles throughout conform to the same type, though in the dorsal tuft a differentiation very early occurs, even in the tenth foot, two or three of these having stronger shafts than the others with more evident cameræ. These bristles, which have tips, become gradually stronger and more deeply tinted in the posterior feet, until toward the tail only two very robust bristles and one or two more slender remain in this division. The bristles of the inferior setigerous process are slender throughout.

In an example of the epitokous female, which had about one hundred and forty-seven bristled segments, the feet remain of the normal pattern to the forty-seventh, on the ventral border of which, close to the inner edge of the ventral cirrus, a small papilla occurs. This in the forty-ninth foot projects as a narrow lamella. Simultaneously a tendency to the development of a flap or lamella behind the superior setigerous process is observed, and it increases in the succeeding feet until a large, fan-shaped lamella is formed. It thus happens that, with the changes in the other parts of the foot, there is at the sixty-seventh foot, for instance, the following arrangement (Plate LXXIII, fig. 1 *c*). Dorsally is a large, thin, fan-shaped lamella, externally touching the comparatively short dorsal cirrus. The dorsal lamella is a long, semi-translucent, and pointed triangle. The superior setigerous lobe is opaque, blunt, and bifid, having a dense tuft of the swimming bristles with the spine at the inferior edge. The next beneath is a long, pointed,

translucent lobe with four separate frills or lobes at its base ventrally, and it generally lies in front of the bristles pertaining to the former lobe. There the inferior setigerous process bears the large fan-shaped lamella, often with prominent crenations at its outer border inferiorly. In front is the great group of swimming bristles diverging in a fan-like manner at the tip. The ventral lobe is considerably smaller than the dorsal lobe and has a prominent rounded border inferiorly. The lamella to the inner edge of the ventral cirrus is large and fan-shaped, and is joined to a smaller lamella on the outer side of the lobe. From the connate lobes the ventral lamella extends outward but does not reach the tip of the ventral lobe. The connate lamellæ thus take the place of a cirrophore, a change which also occurs subsequently in the dorsal cirrus.

At the hundredth foot the dorsal lamella is large, extending upward nearly as far as the dorsal cirrus, which now projects from the translucent edge of a small process (connate with the dorsal lamella) which bulges externally. The superior lobe of the foot is somewhat less, but retains its elongated triangular outline. The superior setigerous process, its bristles and the long lanceolate lamella beneath, are similar to the sixty-seventh, and so are the parts situated ventrally. The surface of the foot has various specks of black pigment, and in the interior are many ova.

A considerable change takes place at the two hundredth foot. The lamella internal to the dorsal cirrus is now much less, the cirrus seems to be proportionally longer, and it is less distant from the body and the centre of the foot (by the diminution of the entire organ). The superior lobe beneath it is smaller and of a lanceolate outline. The superior setigerous process has amalgamated with the lamella beneath it and the area of the latter is circumscribed. The inferior setigerous process bears a smaller lamella, still with a crenate border externally and inferiorly. The ventral lamella is tongue-shaped, with a straight upper edge and a curved inferior border. The lamellæ at the ventral cirrus are much smaller, but the base of the cirrus is still connected with their border.

Towards the tip of the tail (Plate LXXIII, fig. 1 *d*) the lamella to the inner side of the dorsal cirrus has disappeared, a rounded and somewhat thick eminence marking its position. The dorsal cirrus is long. The superior lobe is more opaque, and the setigerous lobe and its lamella beneath are narrow and long. The inferior setigerous lobe has only a trace of a thin margin superiorly, and forms a long, narrow, pointed process. The ventral lobe is tongue-shaped, and the ventral cirrus still retains a frilled lamella inferiorly and a small process externally. The black pigment-touches continue to the posterior feet, and so do the ova interiorly.

An elongated Nereid was dredged in the Bay of Tunis, on the 3rd September, 1870, in the 'Porcupine' Expedition of that year. In general form and in the absence of paragnathi it resembles a small *Eunereis longissima*, though its coloration appears to differ. The head agrees with that in *Eunereis*, but no eyes are visible. Slight elevations devoid of pigment at the sides may indicate them. The tentacles are short, and the tentacular cirri especially short and slender. The fragment of the body is about 4 ins. long in spirit, and from the slight diminution at the posterior end it probably extended an inch or two more. The surface is finely iridescent, and a dull pinkish band (from the intestine) passes along the centre of the dorsum. The first segment (peristomium) is considerably broader than the next. In the structure of the feet this form agrees very closely with

E. longissima, the only feature being the occurrence of a somewhat regular series of four heterogomph bristles below the upper group in the inferior setigerous lobe. These bristles have the same structure as in the Scotch examples. This appears to be a southern deep-water variety of *N. longissima*.

The segmental organ of *Eunereis longissima* has its trumpet furnished with rather long, ciliated fimbriæ, the latter thus contrasting with the lobes of *N. cultrifera* (Goodrich).

This species was first described by Dr. Johnston, of Berwick-on-Tweed, and he noted its great length, absence of horny processes on the proboscis, and the structure of the feet. It is true De Blainville mentions *Nereis longissima*, Savigny, but no reference to this form occurs in Savigny's 'Système.'

The *Nereis pulsatoria*? of H. Rathke[1] apparently comes very near this species, which extends to the Mediterranean. This view is borne out by the structural features given in his treatise, 'De Bopyro et Nereide.'[2]

Levinsen (1883) observes that the epitokous male has the first thirty-five segments and the female the first forty-six rings unchanged. It is used as bait for pollack and other fishes (Malm).

Parfitt (1867) mentions that Mr. Hearder observed millions of them swimming on the surface of the water in May in Plymouth Sound.

Ehlers (1868), as in many other cases, simplified the synonymy of this form by an investigation of the original types.

The *Nereis* (*Ceratonereis*) *guttata* of Claparède (1868) may be a southern variety of this species which seems to vary considerably in regard to the development of the paragnathi.

Claparède describes two species closely allied to *N. longissima*, from Naples, viz., *Nereis* (*Ceratonereis*) *Ehlersiana*, and *N.* (*C.*) *Kinbergiana*,[3] both of which have paragnathi on the maxillary division of the proboscis in extrusion, none in the basal, yet the first foot of the latter is identical in outline with the British form, and that of the second is not very divergent considering the variation in preparations. The variation in the paragnathi of the British species and the similarity in the feet generally point to a very close relationship between the three forms. Whether Claparède's *Nereis* (*Leptonereis*) *glauca*, a small form apparently approaching the heteronereid phase, has any connection with *Eunereis longissima*, is an open question. The unarmed proboscis, the character of the feet, and other features suggest it.

An allied species (*N. irritabilis*) from the Virginian coast is described by Webster[4] (1879). The mature males and females, after assuming their nuptial dress, are caught swimming at the surface of the sea, the former in much greater numbers.

It is difficult to make out what the *Typhlonereis gracilis* of Hansen[5] (1882) can be except this species.

[1] 'Fauna der Krym,' p. 412, Tab. vii, figs. 1, 4 and 8, 1837.
[2] 'Rigæ et Dorpati,' 1837.
[3] 'Annél. Nap.,' Suppl., pp. 88 and 89, pl. viii, figs. 2 and 3, 1870.
[4] 'Trans. Albany Inst.,' ix, p. 31, etc., 1879.
[5] 'Norsk. Nordhav. Exped.,' p. 31, Tab. iv, figs. 14—19, 1882.

The *Leptonereis vasculosa* of Giard [1] appears to approach this form closely, and is also characterized by the feeble armature of the proboscis.

8. Nereis (Alitta) virens, *Sars*, 1835. Plate LIII; Plate L, figs. 12, 13, and 16—larval and post-larval; Plate LXI, figs. 2 and 2 *a*—head, and figs. 3–5—other parts; Plate LXXIII, figs. 2–2 *b*—feet; Plate LXXXI, fig. 7—bristles.

Specific Characters.—Head typical in outline, with two short tentacles anteriorly. Eyes four, arranged in a trapezoid, toward the posterior part of the head, the anterior pair wider apart, a line from each posterior eye sloping inward and backward to the nuchal bridge. The longest tentacular cirrus is the dorsal of the second pair. Colour bluish-purple, and in the preparations often presenting a longitudinal median groove, the ridge on each side running forward to the frontal tentacle. Body from 1—3 feet in length, and $1\frac{3}{4}$ inches in breadth across the feet in a large specimen, slightly tapered anteriorly, diminishing posteriorly, and ending in an anal segment with two long cirri. Peristomial segment twice the breadth of the succeeding. Dorsum of various shades of iridescent bluish-purple, and the lamellæ of the feet are also finely tinted and iridescent; dorsal cirrus larger anteriorly than in those with foliaceous lamellæ, and of a deep green. Ventral surface pale iridescent pinkish, deeper posteriorly, but in some iridescent bluish, with the belts at the anterior part of each segment of a deeper hue. Proboscis in extrusion greyish-blue, somewhat lighter than the hue of the body. The maxillæ have six teeth. The maxillary segment dorsally has a triangular group of paragnathi with the apex in front, on each side behind the jaw, sometimes forming a double row with the limbs wider apart posteriorly, and two points—one in front of the other—between them. Ventrally a long, rather irregular double row proceeds in the maxillary division backward from each jaw, and in the middle is a transverse belt of points, or a larger group in the central area, and a point or two in the lateral area on each side. The proximal segment has dorsally on the eminence in front of each palpus one or two paragnathi, and between them a single point. Ventrally is an irregular double row of paragnathi on the folds, and a brief interval exists between them and the dorsal points. First foot has a dorsal, a middle, and a ventral lobe, the setigerous process being attached to the anterior face of the middle lobe. These lobes are subequal, and nearly lanceolate in outline. The dorsal and ventral cirri are somewhat short, in neither case reaching the tip of the adjoining lobe. The succeeding feet present a tendency to the increase of the dorsal lobe, so that at the tenth foot it forms a large foliaceous lamella. The superior setigerous lobe has a lanceolate lamella beneath it, whilst, after a gap, the inferior setigerous lobe has one above it in lateral view. The dorsal lamella gradually increases until (as at the thirty-seventh foot) it forms a great lanceolate leaf overlapping that behind. The middle lamella is also large and foliaceous, and the cirri appear small beside it. The foot retains this structure till near the tip of the tail. All the bristles have simple tapering tips, those at the ventral edge of the inferior division having shorter tips of the same kind. The shafts are finely camerated.

Ehlers describes the epitokous form as having the upper lamellæ of the feet much

[1] 'Bull. Sc. Fr. et Belg.,' T. xxii, p. 78, 1890.

enlarged, and the hind lamellæ of the inferior division also enlarged. The ventral cirrus, further, has small leaf-like flaps on its thickened base.

Synonyms.

1835. *Nereis virens,* M. Sars. Beskrivelser, p. 58, Tab. x, f. 27.
1851. „ „ Grube. Fam. Annel., pp. 49 and 127.
1853. „ *grandis,* Stimpson. Synops. Grand Manan, p. 34, f. 24.
1865. *Alitta virens,* Kinberg. Öfvers. Vet.-Akad. Förh., p. 172.
„ „ „ Malmgren. Nord. Hafs-Annul., p. 183.
„ *Nereis Yankiana,* De Quatrefages. Annel., i, p. 553, pl. xvii, f. 7, 8.
„ „ *virens,* idem. Ibid., p. 555.
1867. *Alitta* „ Malmgren. Annul. Polych., p. 56, Tab. iii, f. 19.
1868. *Nereis* „ Ehlers. Börstenw., ii, p. 559, Taf. xxii, f. 29—32.
„ „ *grandis,* Packard. Americ. Nat., ii, p. 275.
1874. *Alitta virens,* McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 199.
1875. „ „ idem. Invert. and Fishes St. Andrews, p. 123.
1876. *Nereis* „ Trumbull. Trans. Conn. Acad., iii, p. 265, pls. 42—44.
1879. *Alitta* „ Webster. Trans. Albany Inst., ix, p. 35.
„ *Nereis* „ Tauber. Annul. Danic., p. 100.
„ „ (*Alitta*) *virens,* Verrill. Check List, U.S. Comm. F. & F., p. 8.
„ „ *virens,* idem. Invert. Viny. Sound. Ibid., p. 591, pl. xi, f. 47—50.
1881. *Alitta virens,* Leslie and Herdman. Proc. R. Phys. Soc., Edinb., vol. vi, p. 274.
1883. *Nereis* „ Levinsen. Vidensk. Meddel. Foren. Kjöbenh., p. 233.
1884. „ „ Webster and Benedict. Rep. U.S. Comm. F. & F., p. 717.
1891. „ (*Alitta*) *virens,* Hornel. Trans. Biol. Soc. Liverp., vol. v, p. 243.
1892. „ *virens* (eyes), Andrews. Journ. Morph., p. 177, pl. ix, f. 3.
1893. „ „ Levinsen. Vidensk. Ud. 'Hauchs.,' p. 329.
1901. „ „ Johnson. Proc. Bost. Soc. Nat. Hist., vol. xxix, No. 18, p. 398.
„ „ „ Whiteaves. Geol. Surv. Canada, No. 722, p. 81.
1902. „ „ McIntosh. Ann. Nat. Hist., ser. 7, vol. x, p. 257.

Habitat.—Small specimens from 10 in. to a foot occur in great numbers along with *Nephthys* in muddy sand on the north side of the pole at the West Rocks, St. Andrews. They are found at various parts of the coast—both east and west—in similar localities. Larger specimens are procured to the east of the Step-rock in the same line of sand. Very large epitokous examples, again, are tossed on the West Sands at St. Andrews after storms in October and April, especially the latter month, as well as in May (E. M.). Shore of the Mersey estuary (Benham). Aberdour (Leslie and Herdman).

Norway (Sars). East coast of N. America (Ehlers). Virginian coast (Webster). Puget Sound, Pacific (Johnson).

Head (Plate LXI, fig. 2) of the typical outline, with two short tentacles anteriorly. Eyes arranged in a trapezoid behind the anterior triangle; anterior pair wider apart; often with lenses. The longest tentacular cirrus is the dorsal of the second pair. Colour, bluish-purple.

Body of 100—173 segments or more, from 1 to 3 ft. in length, and $1\frac{3}{4}$ in. in breadth across the feet, slightly diminished anteriorly, whilst posteriorly it gradually tapers, the feet being proportionally broader, and terminates in an anal segment and

aperture which has a lax, fringed border, except inferiorly, where a smooth portion gives origin to two long cirri. Each of the latter has a dark basal region of a brownish-purple hue on the ventral surface, and is thus distinguished from the adjoining parts. Peristomial segment about twice the breadth of the succeeding. The colour of the dorsum is of various shades of iridescent bluish-purple, the same tint extending to the shorter anterior feet. The finest specimens have the great lamellæ coloured greenish-purple. Others vary according to the prevailing tint of the specimen. The lamellæ are also finely tinted and iridescent, and as they gracefully fold over each other like the slates on a roof the effect is striking. The dorsal cirrus, which is larger anteriorly than in the feet with foliaceous lamellæ, is of a deep green. The ventral surface is pale iridescent pinkish, becoming deeper posteriorly, and with a pinkish belt across the front of each segment. In others this surface is iridescent bluish, with the belts at the anterior part of each segment of a deeper hue. In contraction the tints are darker.

Ehlers (1868) observes that in the atokous form the vent has inferiorly two long cirri, whereas in the epitokous form the vent has a ring of short papillæ.

The proboscis (Plate LXI, figs. 2 and 2 *a*) in extrusion is greyish-blue, somewhat lighter than the hue of the body, and similarly iridescent. Dorsally, in front of the palpi, and on the basal ring, one or two paragnathi (VI) occur on the eminence on each side, with an intermediate point (V), whilst on the maxillary (distal) segment a group (II)—somewhat triangular in outline and with the apex in front—lies on each side behind the jaws, with two points (I) longitudinally arranged between them. Ventrally (Plate LXI, fig. 2 *a*) the basal segment has a somewhat irregular double row (VII and VIII) of paragnathi on the folds, and they leave but a brief interval between them and the dorsal points in front of the palpi. On the maxillary segment a long, somewhat irregular double row (IV) proceeds backward as a longitudinal band from each jaw, and in the middle is a transverse belt of points (III), the larger in a single row behind, and the smaller dotted in front. The maxillæ have six teeth. The smaller examples between tide-marks have, as a rule, the paragnathi more complete than the large epitokous forms stranded on the beach.

From the posterior part of the pharynx pass two elongated cæca, which have internally a coating of blackish pigment-granules, the smaller showing active molecular motion when separated. The walls of the cæca are tough, and longitudinally plaited.

The cœlomic bodies are transparent structures of an elliptical form, the longer diameter having an average of $\frac{1}{1250}$ of an inch (0·02 mm.), many being much shorter and a few longer and larger. Their transverse diameter also varies (Plate LXI, fig. 3). Most of these bodies are faintly striated longitudinally, and similar markings occur in the circular corpuscles. They are protoplasmic, and yield when they encounter obstacles.

Circulation.—The blood must be in considerable quantity in large specimens.

The ultimate fibrils of the ventral muscle presented peculiar fibrillation as if from fine lines crossing each other obliquely. In the centre of the fibril is a granular streak, though in some this could not be made out. Acetic acid and calcium chloride obliterated the streak. A contracted fibril is seen in Plate LXI, fig. 4. Occasionally the streak in the fibril assumes the form of a granular band (Plate LXI, fig. 5), the central region representing the contracted fibril, and the transparent sarcolemma or other muscular element projects externally.

The first foot (Plate LXXIII, fig. 2) has (in spirit) a short and somewhat thick dorsal cirrus, the tip of which does not reach that of the dorsal lobe. The latter is lanceolate, slightly contracted at the base in lateral view, and tapering to a blunt tip. The setigerous process is attached to the anterior face of the second lobe so that only the tips of the bristles project beyond it, and nothing is seen of the process itself from behind. These bristles all have slender, tapering, finely spinous tips (Plate LXXXI, fig. 7, *a*, *b*, *c*) and slightly camerated shafts. The middle lobe is tongue-shaped in lateral view, and its blunt tip projects further than that of the dorsal lobe. The ventral lobe is closely united at its base with the middle lobe, and its vertical diameter is greater in the free region. Its blunt tip scarcely projects as far as that of the former. The ventral cirrus arises close beneath, and its tip does not reach, by a larger interval than in the case of the dorsal, the tip of the ventral lobe.

The third foot, as in other Nereids, has two setigerous lobes, and the lamellæ, especially the dorsal, are somewhat longer. The fourth foot shows a decided increase in the dorsal lamella and in the space between it and the body, and these points continue to increase until at the tenth foot (Plate LXXIII, fig. 2 *a*)—by the development of these parts in breadth and depth—a large foliaceous lobe is formed with the dorsal cirrus amalgamated and chiefly visible on the posterior border. The superior setigerous lobe forms an ovate process in front of the bristles, the tongue-shaped middle lobe, which projects considerably further, being fused with it inferiorly. A gap exists between the foregoing and the inferior setigerous lobe, which has a free lanceolate lamella at its upper and posterior edge. In front of this the setigerous lobe proper is bifid, with a small upper and a larger inferior papilla from which the tip of the spine projects in front of the bristles. The groups of bristles correspond to the ordinary types, but all have simple tapering tips, the inferior group (corresponding to the heterogomph series) having decidedly shorter tips. All the tips of the bristles are finely serrated and have cameræ in the shafts, except a small portion at the base and distal end. The ventral cirrus arises from an elevation on the ventral surface and does not reach the middle of the ventral lobe.

The development of the superior lamella continues behind the tenth foot, and the dorsal cirrus becomes more and more lamellar in position, so that in the region of the thirty-seventh foot (Plate LXXIII, fig. 2 *b*) the maximum is reached. It is true that at the fifty-seventh foot the lamella is proportionally larger, but the foot generally is considerably less. The second lamella is also thin and foliaceous (lanceolate), especially after the anterior third. In life large pale wart-like papillæ occur on the edge of the dorsal lamella. The dorsal and ventral cirri show no blood-vessels, and no cilia, but palpocils occur at the tip of both.

In front of the tail (twelfth bristled foot from the tip) the dorsal lamella still retains its characteristic foliaceous form, the cirrus is longer and more slender, though its tip does not reach that of the lamella. It arises from a slight notch of the dorsal edge of the lamella about its middle. The foot is thinner and more flattened, so that the setigerous papillæ are brought into the vertical line of the edge, and thus do not possess the more complex arrangement they have in front. The tips of the lobes below the dorsal are also more pointed. The ventral cirrus remains short.

J. T. Cunningham[1] describes the segmental organ as a somewhat spherical mass composed apparently of a convoluted tube ending in an efferent duct which opens on the ventral surface. The internal aperture is funnel-shaped and fimbriated and seems to open on the anterior face of the septum. He thinks the generative elements are not discharged through this organ, but by dehiscence through the body-wall.

Reproduction.—In those procured in May the females discharged from the broken surfaces (posterior) a cloud of grass-green ova. They measured from $\frac{1}{800}$ to $\frac{1}{1250}$ of an inch (0·03 – 0·02 mm.), and contained numerous granules that by transmitted light have a pale brownish or greenish aspect, the larger masses especially showing the former tint. On the bottom of the vessel the ova formed a deep grass-green layer. The addition of acetic acid did not affect their colour.

The males when placed in spirit about the end of April (21st) emitted streams of spermatozoa from the bases of the feet. In the fresh specimen the sperms maintain an active wriggling motion. Amongst these are also some bodies longer than the head of the ordinary form, and even more active in movement. The masses of sperms in the cœlom assumed a greyish hue.

The digestive apparatus and the whole organs of the animal at this season (April and May) seem to be modified for the furtherance of reproduction.

In October the small ova occur in masses at the bases of the feet, extending into the lamellæ. To the naked eye they are pale, but under the microscope slightly greenish. Moreover, in the bottom tow-nets toward the end of the month numerous faintly yellow or greenish-yellow larvæ in the trochophore stages are found, with a diameter of about ·228 mm. At the same period an early mesotroch stage is met with. Neither tentacular cirri nor eyes are present, and the snout is short, whilst only traces of the feet in the form of lateral papillæ are observed. A little pinkish-white pigment occurs at the ciliated ring. The next stage presents three bristled feet on each side, though neither eyes nor tentacular cirri are present. Two short tentacles spring from the anterior border of the snout, and two rounded anal cirri occur posteriorly.

Toward the end of October a considerable number of a later stage appeared in the bottom-net, and they were readily recognized by the pale pink pigment in the form of a ring behind the preoral belt of cilia, and also by similar pigment posteriorly on each side of the purplish streak of the alimentary canal (Plate L, fig. 12). The pigment on the head forms a flattened horseshoe, thus readily distinguishing this form, and there are two large eyes, besides two short tentacles, which seem to spring from the ventral edge of the snout, and traces of another process on each side. The preoral ring of cilia is powerful, and seems to be the chief locomotor apparatus. Behind it three long cirri project—probably the representatives of the tentacular cirri, which in somewhat younger stages are considerably shorter. Fourteen or fifteen feet are present, each having a prominent dorsal and a long ventral lobule with a cirrus. Simple bristles occur dorsally. Posteriorly the pygidium has two processes like flattened papillæ, probably the precursors of the anal cirri, and the region has rose-pink pigment. In swimming the tentacular cirri behind the preoral ring of cilia are closely adpressed to the body.

An older stage, of the same date (Plate L, fig. 13), having sixteen bristled segments

[1] 'Quart. Journ. Micros. Sci.,' N.S., vol. 28, p. 256, Pl. xviii, figs. 15 and 16, 1888.

presents a tentacle and a second process (palpus ?) on each side of the snout, whilst the preoral ring of cilia is narrower and the body considerably more elongate. The activity of the ciliated ring is noteworthy, and in addition to its locomotor functions it may aid in obtaining nourishment. Four tentacular cirri of different lengths, viz., the dorsal and ventral of each pair, occur behind the ciliated ring. A long proboscis now separates the mouth from the granular alimentary canal which commences at the seventh bristled foot. The two anal processes are larger. The dorsal lamellæ of the feet are lanceolate and richly ciliated on the edge which is next the body.

Habits.—In confinement a muscular wave occurs from before backward in healthy animals, and the species is fairly hardy, the elaborate coloured drawing (Plate LIII) having been made from those kept for a considerable time fifty miles from the sea-coast. When dying, or when placed in fresh water, they eject the proboscis with the jaws at the tip, and decomposition takes place rapidly with considerable odour. Hornel states that they secrete much mucus from an enormous number of tubules in the lobes of the feet. This species is often used as bait for plaice and other fishes. About the year 1890 the local fishermen began to dig for them, having found for many years that those stranded on the beach after storms were valuable in this respect.

Packard (1868) considered his specimens, which were 17 ins. in length, enormous, in short, "these are princes amongst worms, ranking above the smaller forms by their superior size and organization and their rich imperial dress." If this able and genial naturalist had seen those fully 3 ft. in length at St. Andrews his words would have been even more eloquent.

Ehlers (1868) points out that *Nereis* (*Alitta*) *Brandti*, the *Nereis virens* of Grube, a closely allied species, frequents the Pacific shores of America and the sea of Ochotzk.

A Japanese form, *Nereis* (*Alitta*) *oxypoda*, Marenzeller,[1] from Yokohama, shows great development of the dorsum of the foot between the cirrus and the body, so that the cirrus lies in a hollow between two foliaceous lobes.

Grube's *Nereis virens*,[2] from the shores of Eastern Siberia, comes very near this form, though Malmgren considered it a distinct species. Whether the differences indicated, such as the form of the great dorsal lamella, are due to environment and other factors is still an open question.

J. T. Cunningham (1888)[3] states that he cannot confirm the account of the nerve-cords formerly given.[4] In many sections three or four neural canals are seen, which are not quite symmetrical; these are sections through interganglionic transverse commissures. In the cords between successive ganglia there is seen to be a single pair of canals, one of which is often divided into two. The pair occupies an exactly similar position to that of the neural canals in *Sigalion*." He adds, "Probably he" (McI.) "examined sections of the ganglia in which several canals are often seen. But these have not a constant relative position, and are, I believe, due to the subdivision of the two canals which are seen in the separated cords." A re-examination of the careful sections, unstained and made by the hand, does not lead, however, to any change of the view stated in 1877.

[1] 'Sudjap. Annel.,' p. 12, Taf. ii, fig. 3, 1879.
[2] Op. cit., p. 6, Taf. i, figs. 2, 4, 5 and 6, 1858.
[3] 'Quart. Journ. Micros. Sci.,' N.S., vol. 28, p. 270.
[4] 'Proc. Roy. Soc. Edin.,' 1877.

Cunningham[1] denies that the neural canals are colossal nerve-fibres. He thinks they are supporting structures to prevent the nerve-cords being bent at sharp angles. The canals attain greatest development in worms which are extremely long; and further, in these the nerve-cords are not separated from the epidermis, and therefore are more exposed to danger. The neural canals have a position in relation to the nerve-cords and ventral blood-vessel which is similar to that of the notochord in relation to neurochord and aorta.

H. Parlin Johnson (1901) considers the *Alitta Brandti* of Malmgren and Ehlers, and the *Nereis foliata*, Baird, the same species, and observes that the Pacific examples grow to the length of 50 cm. with a diameter of 25 mm. He had not seen an epitokous form.

Such types as the *Pseudonereis gallapagensis* of Kinberg from the shores of Peru and the Galapagos Islands show the same leaf-like dorsal cirrus, and probably the same vascularity.[2]

9. Nereis (Nereilepas) fucata, *De Blainville.* Plate LII, fig. 6; Plate LXI, figs. 6, 6 *a* —head; Plate LXXIII, figs. 3–3 *c*—feet; Plate LXXXI, figs. 8–8 *b*—bristles.

Specific Characters.—Head of the typical shape, with two subulate tentacles in front. Eyes black, comparatively large, the anterior pair somewhat wider apart and occasionally larger. Tentacular cirri of moderate length. Palpi white, only the distal process being pale. Body 4—9 ins. in length, and segments 95 to 110. Peristomial segment wider than the succeeding. The slender tail has two long cirri. The general hue is buff, enlivened by two white streaks on the dorsum, with the red dorsal vessel between, and a dotted white line along each side. The median white lines begin at the base of the tentacles, enlarge before reaching the eyes, between which they pass, and again contract on the first segment. The last segment has a conspicuous white patch. Ventral surface pinkish buff. The proboscis has dorsally on its maxillary (distal) segment in extrusion a group of somewhat large paragnathi (II) on each side at the base of the jaw. In the space between them a single tooth (I) sometimes occurs. On the ventral surface two groups of paragnathi (IV) also are found, the long axis being oblique, whereas that of the dorsal series is more nearly transverse. Between them in the middle line posteriorly are a few paragnathi (III) arranged transversely. The basal division of the organ has on the eminence in front of each palpus a group (VI) of five or six small paragnathi. Ventrally a row of larger paragnathi in groups of two to four (VII and VIII) occurs in front of the area, and there are groups of minute ones behind, a long interval existing between the dorsal groups and these. The strongly curved maxillæ have from thirteen to sixteen teeth.

First foot chiefly noteworthy for the large size of the dorsal cirrus. Whilst the dorsal lobe in this is bluntly rounded, it gradually increases in size from the tenth to the twenty-seventh, where it forms a great dorsal lamella, pointed externally and rounded internally, the dorsal cirrus projecting from the upper border. Superior setigerous lobe amalgamated with that beneath it, the bristles passing out in front. The second lobe is ovate or ovato-lanceolate. Inferior setigerous lobe bifid, the longer and smaller papilla

[1] Op. cit., p. 275.

[2] C. Gravier, 'Arch. Zool. expér.,' t. x, p. 629, pl. xvi, figs. 15—20, 1909.

anterior. Ventral lobe tongue-shaped. Ventral cirrus extends a little beyond the tip of the foregoing lobe. In the superior division of the foot the bristles have long, tapering, spinous tips, and at the lower edge of the fascicle are a few with stouter shafts and shorter tips. In the inferior division the upper series consists of those like the foregoing, then intermediate forms, and inferiorly a dense group of bristles with short tips (heterogomph).

The change in the feet of the epitokous female begins in the twenty-first foot as a slight enlargement at the inner border of the ventral cirrus. A similar process appears at the inner base of the dorsal cirrus of the twenty-sixth or twenty-seventh foot. These lamellæ increase to the sixtieth foot and again diminish. Coincident with these a small lamella occupies the posterior surface of the inferior setigerous process. In one specimen the bristles retained the normal form, yet the ova were nearly ripe. Ehlers observes that the change in the feet of the epitokous male begins in the seventeenth foot.

Synonyms.

1820. *Lycoris fucata,* Savigny. Syst. Annel., p. 31.
1825. *Nereis* „ De Blainville. Dict. Sc. Nat., t. xxxiv, p. 436.
1828. *Nereilepas fucata,* idem. Ibid., t. lvii, p. 468.
„ „ „ idem. Ibid., t. lvii, p. 469.
1833. *Nereis* „ Audouin and Edwards. Ann. Sc. Nat., tom. xxix, p. 210.
1834. „ „ idem. Annél., p. 188.
1839. „ *bilineata,* Johnston. Ann. Nat. Hist., iii, p. 295, pl. vi, f. 4.
1840. „ *fucata,* idem. Ibid., v, p. 175, fig. 7.
1851. „ „ Grube. Fam. Annel., pp. 49 and 127.
1855. „ *bilineata,* Thompson. Ann. Nat. Hist., 2 ser., vol. xvi, p. 78.
1865. „ „ Carrington. Annel. Southport, p. 8.
„ „ *imbecillis,* Johnston. Cat. Worms Brit. Mus., p. 156 (excl. syn. Grube, *fide* Malmgren).
„ *Nereilepas fucata,* idem. Ibid., p. 158.
„ *Nereis* „ De Quatrefages. Annel., i, p. 547.
1867. *Nereilepas* „ Malmgren. Annul. Polych., p. 53, Tab. iii, f. 18.
„ „ „ Parfitt. Trans. Devon. Assoc., ii, p. 22 (sep. copy).
1868. *Nereis* „ Ehlers. Börstenw., ii, p. 546, Taf. xxi, f. 41—44, Taf. xxii, f. 1—4.
1870. „ „ Grube. Arch. f. Naturges., Bd. xxxvi, p. 307.
„ „ *bilineata,* idem. Ibid., p. 304.
1873. „ *fucata,* Verrill. Invert. Viny. Sound, U.S. Comm. F. & F., p. 591.
1874. *Nereilepis fucata,* McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 199.
„ „ „ Malm. Göteb. vet. o. vitt. Handl., xiv, p. 84.
1875. „ „ McIntosh. Invert. and Fishes St. Andrews, p. 123.
1879. „ „ Tauber. Annul. Danic., p. 99.
1883. *Nereis* „ Levinsen. Vidensk. Medell. Foren. Kjöbenh., p. 233.
1890. „ „ Malaquin. Annél. Boulon, p. 30.
„ *Nereilepas* „ idem. Rev. biol. Nord France, t. ii, p. 2 (*fide* De St. Joseph).
1891. *Nereis* (*Nereilepas*) *fucata,* Hornel. Trans. Biol. Soc. Liverp., vol. v, p. 242.
1895. *Nereilepas fucata,* Coupin. La Nature, 1^{e} semestre, p. 29 (*fide* De St. Joseph).
1898. *Nereis fucata,* De St. Joseph. Ann. Sc. Nat., 8^{e} sér., t. v, p. 300, pl. xvi, f. 83—87.
1902. *Nereilepas fucata,* McIntosh. Ann. Nat. Hist., ser. 7, vol. x, p. 257.
1904. *Nereis* „ Allen. Journ. M. B. A., n.s., vol. vii, p. 224.
1906. *Nereilepas* „ Eisig. Fauna u. Fl. Neap., xxviii, p. 158 *et seq.*

1908. *Nereis fucata,* Ehlers. Deutsch. Tiefsee-Exped., p. 71.
1909. *Nereilepas fucata* Elwes. Journ. M. B. A., N.S., vol. viii, p. 351.
„ „ „ Lo Bianco. Mitth. Zool. Stat. Neap., Bd. xix, p. 582.

Forma epitoca.

1771. ? *Die faserige Nereide,* O. F. Müller. Von Würmern, p. 144, Tab. viii.
1776. *Nereis fimbriata,* idem. Prodr. Zool. Danic., No. 2627.
1791. „ „ Linn. Syst. Nat. (Gmelin), ed. 13, i, pt. 6, p. 3115.
1833. „ *podophylla,* Audouin and Edwards. Ann. Sc. Nat., t. xxix, p. 211, pl. xiii, f. 13.
1834. „ „ idem. Annél., p. 189, pl. iv A, f. 13.
1865. *Nereilepas fimbriatus,* De Quatrefages. Annel., t. i, p. 559.
„ „ *margaritaceus,* idem. Ibid., p. 562.
„ *Heteronereis margaritacea,* Johnston. Cat. Worms Brit. Mus., p. 166.
„ „ *renalis,* idem. Ibid., p. 163.
„ „ *glaucopis,* Malmgren. Nord. Hafs-Annul., p. 110, Taf. xi, f. 16, 16 A.
1867. „ „ idem. Annul. Polych., p. 60, Taf. iv, f. 26, 27.
1869. *Nereis fucata,* Grube. Schles. Gesell., 1868—9, p. 113, sep. copy, p. 5.
1874. *Heteronereis glaucopis,* Malm. Göteb. vet. o. vitt. Handl., xiv, p. 84.
1888. *Nereis fucata,* Wiren. Svensk. Vet. Akad. Handl., Bd. xiv, afd. iv, No. 5, p. 1—14, Taf. i—iii.
„ „ „ *B inquilina,* idem. Ibid., p. 9, Taf. i—iii.

Habitat.—Generally distributed round the shores of Britain, including Ireland, from the eastern to the western borders. Abundant in deep water off St. Andrews Bay, and frequently commensalistic with *Pagurus Bernhardus* in *Buccinum*, both the large and the smaller (littoral) varieties, and in *Fusus Islandicus*. Part of the annelid is inserted within the shell, and the anterior region lies along the lip. Large examples are also thrown on the beach after storms (E. M.). Dr. Johnston found his specimens in the same or allied shells with Hermit-crabs. Stomach of cod and haddock, St. Andrews (E. M.). Large examples from the deep water off Montrose (Dr. Howden). In 80 fathoms eighteen miles west of Skellig, Ireland (J. G. Jeffreys). Torquay (Elwes).

Shores of France (Audouin and Edwards). North Sea (Ehlers, Levinsen, etc.). Eastern American shores (Verrill).

Head (Plate LXI, fig. 6) of the typical shape, terminated anteriorly by two subulate tentacles which are about the length of the head. Eyes black, comparatively large, the anterior pair somewhat wider apart, and often larger than the posterior. The palpi are normal, and the tentacular cirri of moderate length.

Body 4—8 or 9 ins. in length, slightly narrowed anteriorly, and diminished to a slender tail terminated by two long cirri posteriorly. Segments from ninety-five to one hundred and ten. The peristomial segment is wider than the succeeding. The general hue is buff, enlivened by two white streaks along the dorsum with the red dorsal blood-vessel between, and a dotted white line along each side. The two median white lines begin at the base of the tentacles, enlarge before reaching the eyes, between which they pass, and again contract behind them on the first segment. They continue to the tip of the tail, the last segment having a conspicuous white patch. On the arch of each segment a white streak passes outward toward the white dorsal process of each foot. In the anterior feet the white pigment is less developed, and it is rare for the pigment on the arch of the foot to unite with the central white lines. The palpi are white, only the

distal process being pale or slightly translucent. The tentacles and cirri are pale. In some the yellowish buff is best marked over the bases of the feet anteriorly, leaving a pale belt on each side of the central white line. The ventral surface is pinkish buff.

The proboscis (Plate LXI, fig. 6) has dorsally in front of each palpus a group (VI) of five or six small paragnathi. Upon the maxillary segment near the base of the jaws is on each side a group (II) of larger, pointed paragnathi, the groups separated by a wide interval, in which (I) a single tooth sometimes occurs. Ventrally (Plate LXI, fig. 6 *a*) the basal segment has a row of larger paragnathi (VII and VIII) in front in groups of two to four, and a series of minute ones behind, a long interval occurring between the dorsal groups of this division of the organ. Distally are two lateral groups (IV) of distinct paragnathi, the long axis being oblique, whereas the long axis of the corresponding dorsal series (II) is more nearly transverse. Between them in the middle line posteriorly are a few paragnathi (III) arranged transversely. The maxillæ, which are strongly curved at the tip, have from thirteen to sixteen teeth.[1] Paragnathi II and IV are often the most conspicuous in size.

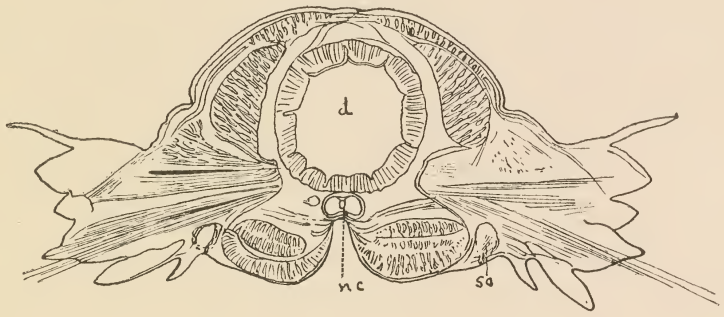


Fig. 75.—Transverse section of the body-wall of *Nereilepas fucata*. Letters as before.

In connection with the food of this species, De Haan[2] records that *Lycoris fucata* devoured *Teredo*.

In transverse section the arrangement of the ventral longitudinal muscles and their reflection is similar to that of *Nereis pelagica*. The nerve-cords show a median neural canal, and two lateral canals which are situated near the external border of each nerve in the interganglionic areas (Fig. 75).

The *segmental organs*[3] agree generally with the type which has already been alluded to on p. 250.

The first foot (Plate LXXIII, fig. 3) is chiefly remarkable for the large size of the dorsal cirrus. The dorsal lobe is bluntly rounded, the setigerous lobe pointed, and the ventral lobe is bevelled to a blunt tip. The ventral cirrus extends considerably beyond it. There are two black spines passing to the apex of the setigerous region. The superior group of bristles consists chiefly of those with long tapering tips and spinous edges (Plate LXXXI, fig. 8), but there is at least one with a short terminal piece slightly

[1] Levinsen gives a *resumé* of teeth according to series I, II, etc., 'Vidensk. Meddel.,' 1883, and Tauber (op. cit.) notices the variability of the paragnathi.

[2] 'Zool. Record,' 1866, p. 586.

[3] Vide Goodrich, 'Quart. Journ. Micros. Sci.,' vol. xxxiv.

curved at the tip as in the next series (heterogomph), sometimes two or three. The inferior group presents bristles with somewhat shorter tapering and spinous tips superiorly (Plate LXXXI, fig. 8 *a*), then a few having medium tips with a very slight curve, and inferiorly those with shorter tips with a curved probe-point (Plate LXXXI, fig. 8 *b*).

The double bristle-tuft appears in the third foot as in allied forms. At the tenth foot (Plate LXXIII, fig. 3 *a*) the outline trends from above downward and inward. The dorsal cirrus is long and slender, stretching far beyond the tip of the conical superior lobe. The superior setigerous lobe is represented only by the bristles. The lobe beneath it is irregularly conical and considerably less than the superior. The inferior setigerous lobe is bifid and has two strong fascicles of bristles. The ventral lobe is less than either of the preceding and conical at the tip. The ventral cirrus does not reach the extremity of the latter. The bristles of the superior lobe have long tapering tips; those of the inferior are in two groups—the upper having bristles with long tips above and with short tips below. The inferior group has only those with short tips (epitokous female).

Towards the enlarged end of the shaft the camerated region of the bristles is narrowed, and the markings are less regular. At the base of the shaft the cameræ become indistinct, and the diameter of the bristle is less. The spines are rather brittle. At the base they are pellucid, then brownish, and finally black distally. The inferior spine is the stronger.

Reproduction.—Two females having the body distended with ova of moderate size came from deep water off St. Andrews Bay in January (E. M.). Others with large ova were tossed on shore after storms the same month. One in March had smaller ova. In October the reproductive elements are but slightly developed. Prof. Garstang[1] and Dr. Allen give May as the breeding season at Plymouth; whereas Lo Bianco has found mature forms in October and November as well as from April to July. In the ripe condition the ova extend forward to the anterior region; whilst the coloration of the posterior end of the body in some is lost by the prominence of the internal mass of greyish ova (De St. Joseph).

In an incipient epitokous female from Cornwall, kindly sent by the late Dr. Baird, a slight enlargement is observed at the inner border of the ventral cirrus of the twenty-first foot. This increases at the thirtieth to form a small lamella adherent to the inner border of the cirrus. This lamella continues to the sixtieth and again diminishes, disappearing about the seventieth foot. In the same way a slight enlargement appears at the inner border of the base of the dorsal cirrus about the twenty-sixth or twenty-seventh foot. Behind this it by-and-by forms an elevated crest, and continues to the same region as the former. Coincident with these a small lamella occupies the posterior surface of the inferior setigerous process, its margin in lateral view being visible above and below the lobe, but very little of it is seen at its tip. Traces of this continue beyond the seventieth foot, and then disappear. The bristles retain the normal form in this specimen, no swimming bristles being present. The ova are ripe or nearly so.

In an epitokous female the dorsal lobe of the foot gradually increases in size after the tenth, until at the twenty-seventh (Plate LXXIII, fig. 3 *b*) the upper region of the foot, including that between the dorsal cirrus and the body and the dorsal lobe, forms a

[1] 'Journ. M. B. A.,' vol. iii, p. 225.

great lamella pointed externally (apex of dorsal lobe) and rounded internally, with the dorsal cirrus projecting from the upper border. The setigerous lobe is amalgamated with that beneath it, the bristles, which have cylindrical shafts regularly camerated, and long, tapering tips, passing outward from the base in front. The second lobe is somewhat ovate or ovato-lanceolate. The inferior setigerous lobe is bifid, the longer and smaller papilla being anterior. The superior bristles have long tapering tips delicately serrated. The inferior group consists of those with long tapering tips (somewhat shorter than the upper series) superiorly, then intermediate forms, and inferiorly a dense group of those with short falcate tips as in the figure, the edge being beset with spines. The ventral lobe is tongue-shaped, and the ventral cirrus, which extends a little beyond the tip of the lobe above, arises from an eminence of its own.

The huge superior lamella somewhat increases in size proportionally, especially in its vertical diameter, from the foregoing to the fifty-seventh foot (Plate LXXIII, fig. 3 *c*) but, except a slight increase in the size of the middle lobe, the foot does not essentially alter. The apex of the dorsal lobe, however, becomes slightly more bulbous than in the twenty-seventh, and about the sixty-eighth or seventieth the foot presents an opaque brownish glandular aspect. This brownish glandular condition becomes more marked in the succeeding segments to the tip of the tail. About the same region (seventieth foot) a tendency to a similar thickening occurs in the middle lobe of the foot, and at the ninety-fourth foot the brownish coloration marks the contents. The terminal segments thus have a brownish touch at the tip of each of these lobes, and the middle lobe has slightly increased in size. The ventral cirrus is also longer, reaching beyond the tip of the ventral lobe.

In the fully developed epitokous form both divisions of the feet glisten with the swimming bristles, which have broad, sabre-shaped tips.

Habits.—Young forms occur in large numbers in the crevices of stones and shells from deep water and on *Filigrana*. The young thus follow a different habit from those adults which become commensalistic with the hermit-crab in the shells of mollusks. W. Thompson mentions one at Weymouth which constructed a free tube inside the shell of the whelk. The motions of the annelid are very graceful.

In a young example about $1\frac{3}{4}$ ins. long procured with many others on a mass of *Filigrana implexa* near the Bell Rock, the dorsal edge of the fourth foot on the right was fused with a calcareous growth, apparently of a young *Cellepora*, which had fixed itself on the dorsum near the base of the foot, which thus by-and-by had become involved in the growth.

In sickly examples the caudal segments long retain vitality whilst the anterior region is blanched in death, the opposite condition of that occurring for instance in *Polydora*, in which the anterior region is active whilst the posterior is decayed. It is used as a bait for whiting.

This is the *Nereis imbecillis* (Mus. Leach) from Sandgate, Kent, in the British Museum.

The commensalistic habit of this species has not resulted in much structural change, and in this respect it diverges from the *Lycastis* (*Anoplonereis Herrmanni* of Giard,[1]), which

[1] 'Compt. Rend.,' August 21, 1882, p. 389; and 'Ann. Nat. Hist.,' ser. 5, vol. x, p. 330.

has an altered superior division of the foot (absence of the superior ligula) with simple capillary bristles, and the jaws have disappeared, whilst there is a third median tentacle. This species was found by the late Prof. Giard[1] in the tunnels of *Balanoglossus*. A survey of other commensals amongst the Polychæts leads to a similar conclusion as regards structural alteration. Moreover, the groups in which this habit has been developed are few, the most conspicuous being the family of the Polynoidæ which haunt the tubes of Terebellids and Chætopterids, the ambulacral grooves of Echinoderms, grooves in mollusks, and occur on Hydrocorallines or within the framework of Venus's Flower Basket. The Hesionids have few examples, the best known being *Ophiodromus flexuosus* on *Astropecten* and *Luidia*. Syllids, again, are common in sponges, the unique *Syllis ramosa* permeating the canals with its branches; Eisig[2] excludes *Polydora* in the group "Endo-Commensalen" since it perforates oyster-shells so extensively, but it also does the same in various rocks, and in such a case is no more a commensal than *Cliona*.

In Montagu's MS. volume of drawings (1808) in the Linnean Society this species is represented in Plate LI, fig. 3.

Chamisso and Eysenhardt[3] (1819) describe from Unalascha a *Nereis heteropoda* which appears to resemble *Nereilepas fucata* very closely, though the authors place the change in the form of the foot at the forty-third. They may, however, refer only to the full development of the altered foot.

In accordance with their views Audouin and Milne Edwards (1834) considered the enlarged dorsal lamellæ as specially branchial. Their *Nereis podophylla* is a female epitokous form of the present species.

The *Nereilepas fusca* of Œrsted (1843) is probably the same form.

Ehlers (1868) did good service in rectifying the synonymy of this species.

Claparède (1868) adopted *Nereilepas* as a sub-genus, following Johnston and Malmgren rather than Œrsted, Kinberg, and De Quatrefages, though *Stratonice*, Malmgren, was included.

He describes two species of the genus from Naples, viz., *N. parallelogramma* (the *N. pulsatoria* of Grube), and *N. caudata* of Delle Chiaje. Both species seem to be in need of revision and accurate comparison with *N. fucata*. Claparède saw vibratile cilia on the lamellæ of the latter species leading by grooves to apertures out of which he supposed the sexual elements escaped. This needs confirmation. In Delle Chiaje's figure of what appears to be a foot (Plate CII, fig. 15[4]) the structure is inverted.

Wirén (1888) gives a careful account of this form in the atokous and epitokous conditions, indicating the changes in the feet and body-wall respectively. He terms the epitokous form var. *inquilina*. The diminution of the muscular layers in this condition is marked, as in other annelids under the same circumstances. It occurs, as in Britain, in shells covered with *Hydractinia* and inhabited by hermit-crabs.

[1] 'Compt. Rend.,' August 21, 1882, p. 389; and 'Ann. Nat. Hist.,' 5th ser., vol. x, p. 330 (as *Anoplonereis Herrmanni*).

[2] 'Fauna u. Fl. Neap.,' xxviii, p. 167.

[3] 'De Anim. Quibusd.,' etc., Fascic. ii, p. 349, Taf. xxiv, fig. 2, 1821.

[4] 'Descriz. Anim. Invert.,' vol. iii, p. 96, Tav. cii, figs. 10 and 15, and 'Mem.,' vol. ii, pp. 403 and 426, Tav. xxviii, figs. 100, 115.

Hornel (1891) states that the worm takes possession of the shell of the mollusk first, and that it tolerates the intrusion of the hermit-crab for benefits subsequently received. This is uncertain. It is more probable that the same affinity as in other commensalistic forms holds.

De St. Joseph (1898) considered Wiren's view that the posterior region of the body was furnished with thinner longitudinal muscles to fit it for its peculiar habitat was untenable, and that such was only a step to the Heteronereid condition.

At Naples Lo Bianco[1] (1909) finds that this species especially frequents Prosobranchs inhabited by *Eupagurus Prideauxii*.

Family XI.—Eunicidæ.

Head somewhat triangular or semi-oval, with lobate palpi more or less united, rarely lateral tentacles, or none. Tentacles subulate or elongate posteriorly; sometimes none. Eyes two or four or absent. Nuchal organs in the form of ciliated grooves (Racovitza). Body long, vermiform, often slender, somewhat rounded, iridescent, with numerous short segments, ending in two or four anal cirri. Peristomial segment bi-annular, with two tentacular (nuchal) cirri or none. The body-wall is characterized by its great muscularity, and the nerve-cords are comparatively large, and lie in the interval between the ventral attachments of the oblique muscles. Externally are the basement-tissue, the hypoderm, and the cuticle. The changes made by the ripe sexual elements in the male are indicated in Fig. 76. Proboscis with paired or unpaired horny or calcareous plates; one superior maxilla with hooked tip on each side, simple or toothed; great dental plates hooked anteriorly, toothed, truncate or convex, besides smaller anterior and lateral plates. Mandibles[2] chisel-shaped. Feet simple or double, bearing dorsal (often with bristles) and ventral cirri, one or more spines, and one or two fascicles of bristles; often without cirri, but with a setigerous lobe. Bristles simple or simple and compound; the former sometimes slender, winged, the latter with hooked tips. Uncinate spines posteriorly.

Branchiæ springing from the dorsal cirrus in the form of simple styles or pectiniform or sub-fascicular, and occasionally as spiral tufts, or absent. Blood has hæmoglobin.[3]

Goodrich states that the segmental organs are always provided in the adult with large funnels opening into the cœlom, and they perform the function both of excretory and genital ducts. They were misunderstood by the earlier observers, such as Ehlers. Fage[4] considers they have a close analogy with those of the Syllidæ, though they differ

[1] The recent loss of this able observer at the Naples Zoological Station must be deplored not only by the staff, but by every marine zoologist.

[2] In the figure in the 'Cambridge Nat. Hist.' (p. 270, fig. 140, L) these organs appear to have been inverted.

[3] Ray Lankester, 'Proc. Roy. Soc.,' No. 140, p. 2, 1873.

[4] 'Ann. Sc. Nat.,' 9e sér., pp. 347—352, figs. 36 and 37, pl. vii, f. 32—36.

in so far as the opening into the cœlom is by a large and permanent genital funnel, instead of by a small nephrostome as in the family mentioned. They transmit the genital products.

The sexes occasionally exhibit, as in *Eunice norvegica*, considerable differences—for instance, in the branchiæ.

The larva passes through two ringed prototroch, and through metatrochophore and nectochæte stages (Häcker).

Some secrete tubes—hyaline, papyraceous, or strengthened with fragments of shells, stones, or sea-weeds, and they may be slightly branched; whilst others frequent tunnels of sandy mud in clefts and fissures of rocks, or under tangle-roots and the crusts of *Lithothamnion*. Mr. Crossland[1] observed *Eunice siciliensis* in the Red Sea in long, tortuous holes, lined with parchment-like material. He thinks the importance of this form is noteworthy in breaking down coral, for it not only eats considerable quantities, it may be for the parasitic algæ found in stony corals, but its tunnel enables *Chone* to gain an entrance. He is inclined to think the dental apparatus is the boring apparatus as in *Lysidice*, but such has not yet been proved.

Audouin and Milne Edwards (1834) observe that in the Eunicidæ the jaws attained the maximum development, and that some forms (Lumbrinereidæ) had a symmetrical arrangement (four on each side), whilst others show irregularity in this respect (*Eunice*, *Aglaura*). They point out the uniramous feet and the presence or absence of branchiæ, which form a more or less pectinate fringe or a spiral. They divide the group into Branchiate and Abranchiate, the former including *Eunice*, *Onuphis*, and *Diopatra*, the latter *Lysidice*, *Lumbrinereis*, *Aglaura*, and *Œnone*. They term the mandibles the inferior jaws. The maxillæ of this work are their superior pair; the second pair are their maxillæ; the third pair (from behind) correspond to the anterior plates, whilst their supernumerary plate is the azygos plate. They arrange the species according to the presence or absence of the tentacular cirri.

Grube,[2] after Savigny, grouped in his early work the genus *Eunice* along with *Diopatra*, *Onuphis*, *Lumbriconereis*, *Aglaura*, and *Œnone* under his third family, Eunicea.

Dr. Thos. Williams[3] states that the segmental organs are large in *Eunice*, and the branchiæ closely connected with them. The generative products are contained in delicate areolar tissue. The ciliated segmental tube and its appended vascular tuft are not easily seen, though more saccular and prominent than in *Nereis*. He figures, in *Eunice gigantea*, the organ as loop-like in connection with a blood-vessel. He observes that the female is nearly twice as large as the male at the reproductive season.

Kinberg[4] gave as the general characters of the Eunicea (Sav.) coadnate mandibles and longitudinal maxillæ, of which the first lamina is present. The Eunicea proper, again, have seven to nine maxillæ, part ii edentate; five tentacles, and neither antennæ nor palpi. The buccal segment is double. He arranged the genera according to the form of the

[1] I am much indebted to my friend for many useful notes from the Red Sea.
[2] 'Fam. Annel.,' p. 44, 1851.
[3] 'Philos. Trans.,' p. 127, pl. viii, fig. 20, 1858.
[4] 'Öfvers. af k. Vet.-Akad. Förh.,' 1864, No. 10, pp. 559 and 561.

cephalic lobe, the presence or absence of tentacular cirri, and the condition of the branchiæ.

Dr. George Johnston (1865), following Audouin and Edwards, grouped the Eunicidæ according to the presence or absence of branchiæ, dividing those devoid of gills into those with antennæ and those in which these were absent or rudimentary.

The same author[1] thought that, following the Amphinomaceæ, the Euniceæ, his third family, made the connection between the first-named and the Nereids less abrupt. He included seven species of *Eunice* in the British Fauna, viz., *Eunice norvegica*, *E. annulicornis*, *E. antennata*, *E. Harassii*, *E. gigantea*, *E. sanguinea*, and *E. margaritacea*. Two of these, only casually alluded to by Dr. Williams, may be withdrawn, and probably refer to well-known forms. The first two also are probably synonymous, and the last refers to *Marphysa sanguinea*. Besides these, *Onuphis conchylega* and *Hyalinœcia tubicola*, *Lysidice ninetta* and *Arabella tricolor*, represent the other groups.

De Quatrefages (1865) followed Schmarda in separating Savigny's family of the Eunicidæ into two, viz., the Eunicidæ and Lumbrinereidæ, the one characterized by branchiæ, the other by their general absence. He thought the Eunicidæ were the most elevated type of Annelids and contained some of the largest forms. He divided the family into two groups according to the number of the tentacles (his antennæ), *Eunice* and *Marphysa* having five, whilst *Diopatra* and *Onuphis* have seven, a sub-division in each being made by the absence or presence of tentacular cirri (his tentacles). He terms the maxillæ the superior maxillæ; the great dental plates are his inferior maxillæ; the other pieces are comprehended under his two pairs of denticles. The mandibles are his *labrum*.

Ehlers (1868) describes the Eunicea, Grube (char. auct.), as having an elongated segmented body, cephalic lobe rounded, either with or without tentacles and palpi, or neck-pads; mostly with eyes. Foot generally single, or double, without appendages or lobes; dorsal and ventral cirri and branchiæ with compound and simple bristles, or with only simple bristles. Four anal cirri under the vent. Proboscis with jaws, the upper of several joints, and with two plate-like lower jaws.

He[2] divided the family Eunicea into two great groups, viz., the *Eunicea labidognatha* and the *E. prionognatha*. The former has the interposing pieces of the upper jaw heterogeneous. The pieces following the "Träger," and the untoothed pincers (Zange), become surrounded by a half circle of smaller pieces. The feet single, with several bundles of bristles.

This he subdivided into those in which the two halves of the upper jaws have an unequal number of pieces—one more in the left than in the right. Cephalic segment with tentacles (*E. labidognatha tentaculata*). Under the second division of this group—with five long posterior and two stumpy anterior tentacles are *Diopatra*, Aud. & Edw., with two tentacular cirri, and *Onuphis* devoid of them. Under the third division with five tentacles and branchiæ are *Eunice*, Cuvier, with two tentacular cirri, and *Marphysa*, De Quatrefages, in which these are absent. In the fourth division is *Nicidon*, with five tentacles and no branchiæ. In the fifth division occurs *Lysidice*, Savigny, devoid of branchiæ.

[1] 'Cat. Worms Brit. Mus.,' p. 129, 1865.

[2] 'Borstenwürmer,' ii, p. 280, 1868.

Under the sixth division are *Nematonereis*, Schmarda, with dorsal cirri, and *Blainvillea*, De Quatrefages, without them.

In the second series of this group both halves of the jaws have an equal number of pieces; no true cephalic tentacles (*E. labidognatha nuda*). It comprises *Ninoë*, Kinberg, with branchiæ, and *Lumbriconereis*, Blainville, without them.

In the second great group (the *Eunicea prionognatha*) he makes two divisions, viz., first, the *E. prionognatha monocopa*, in which the feet are single and the bristles simple. In the first section the dorsal cirri are stunted or absent; the first pair of teeth with pincer-shaped hooks at the tip and alike. *Aracoda*, Schmarda, has five pairs of teeth, whilst in *Arabella*, Grube, the first pair of teeth are unlike. In these all the teeth are similar. In the group following the first pair of teeth is devoid of pincer-shaped ends. In this he places *Notocirrus*, Schmarda, with stunted dorsal cirri. In the second division the pinnæ are bifid, with simple and compound bristles, and under this is *Staurocephalus*, Grube.

Claparède, in his 'Supplement' (1870), takes up the subject of the teeth of the Eunicidæ, and compares his nomenclature with that of Ehlers.

Ehlers:	*Claparède:*
Träger . . .	Support (most posterior piece).
Zange . . .	Pince.
Zahn . . .	Deut, or piece dentaire.
Sägeplatten . . .	Plaques en scie
or	or
Reibplatten . . .	Plaques en rape (Claparède would call latter paragnathes).
	Maxillaire inferieure (for lower jaw).

He is of opinion that while he may have minimized their importance, Ehlers has exaggerated it—in classification. He thinks that Ehlers' Labidognathes and Prionognathes pass gradually into each other. Whilst the jaws may be utilized in a certain measure for tribes, their employment is difficult in constituting genera, for the same form of jaw occurs in different genera. The importance of the shape of each piece is less than Ehlers supposes. Claparède found great variations in the jaws of the same species. He further observes that the group (Eunicea) has large tubular fibres on the dorsal surface of the nerve-area.

At a later period Grube, in his 'Philippine Annelids,' describes the Eunicea (and he includes *Staurocephalus*) as having a subtriangular or semi-oval head, with lobate palpi (his subtentacles) more or less united, rarely lateral tentacles or none. Tentacles subulate or elongate posteriorly, sometimes none. Eyes two or four or absent. Body long, vermiform, often slender, sometimes rounded, iridescent, with numerous short segments, ending in two or four anal cirri. Buccal segment biannular, two tentacular cirri or none. Proboscis with paired or unpaired horny or calcareous plates. One superior maxilla with hooked tips on each side, simple or toothed; inferior laminæ hooked anteriorly, toothed, truncate or convex. Branchiæ simple styles or pectiniform or subfascicular, occasionally spiral, springing from the dorsal cirrus, or absent. Feet simple, dorsal and ventral cirri, one spine or more; one or two fascicles of bristles, often without cirri, but with a setigerous lobe. Bristles simple, or along with compound bristles; sometimes slender,

scalpriform; apex truncate and pectiniform. Inferior setæ or spines posteriorly uncinate. Some make tubes—hyaline, or with fragments of shells, stones, and sea-weeds.

He divided them into three main groups, viz., (1) the *Labidognatha*, with unequal pieces in the jaw-apparatus: (2) the *Lumbriconereidea*, which he again subdivided into those with leaf-like dorsal cirri, and those without dorsal cirri; and (3) the *Stauro-cephalidea*.

Grube[1] subdivides *Eunice* as follows:

Two tentacular cirri .	Frontal border 4-lobed . .	S.-g. *Eriphyle*, Kbg.
	„ „ 2-lobed . .	S.-g. *Leodice*, *s.st.* Gr.
No tentacular cirri .	„ „ 2-lobed or entire .	S.-g. *Marphysa*, Sav.

In the same paper he subdivides the sub-genus *Leodice* (1) according to the presence of the branchiæ in the middle region of the body and their absence posteriorly, and (2) those species in which the branchiæ are continued to the end of the body or nearly so. He adopts the same arrangement with *Marphysa*. He appends *Lysidice*, *Amphiro*, and *Nematonereis* without special heading, distinguishing *Lysidice* according to the position of the median tentacle.

The Eunicidæ form the first family of Levinsen's Euniciformia vera, the first division of his Euniciformia (1883). Benham makes it the ninth family of his Nereidiformia. Both link on the Glyceridæ, the former as a division, and the latter as merely the succeeding family of the sub-order.

Pruvot (1885) considered the appendages on the second segment of the body in certain forms as homologous with the dorsal cirri. He gave a careful description of the nervous system of several types of the group.

The nuchal organs are in the form of ciliated grooves, and may be protected by the border of the first segment (Racovitza).

Ehlers, in his 'Florida-Anneliden' (p. 67), groups the tentacle-bearing Eunicidæ as follows:—

No. of tentacles.	Without tentacular cirri.		With tentacular cirri.	
	Without branchiæ.	With branchiæ.	Without branchiæ.	With branchiæ.
7	Onuphis (Paronuphis)	Onuphis	Diopatra (Paradiopatra)	Heptaceras Rhamphobrachium Diopatra
5	Paramarphysa	Marphysa	Nikidion	Eunice
3	Lysidice	Amphiro	—	—
1	Nematonereis	—	—	—

[1] 'Jahresber. der schl. Gesellsch. für vaterl. Cultur,' 1877, t. lv, p. 98.

He discusses the supposed jaws of Eunicidæ found by Dr. Hinde in the Silurian strata, and points out that no mandibles have been described. He mentions the Rotifera as having similar structures. He also adheres to his former classification of the Eunicidæ as a whole.

Gravier [1] classifies the Eunicea as follows:—

EUNICEÆ—three tribes.

One dorsal cirrus and one ventral cirrus	Superior jaw formed of pieces, few in number (generally three)	Eunicidæ.
	Superior jaw formed of small pieces (teeth), numerous, and arranged longitudinally	Staurocephalidæ.
No ventral cirrus	Dorsal cirrus rudimentary or foliaceous	Lumbriconereidæ.

Gravier again divides *Eunice* into—

No branchiæ			*Nicidon*.
With branchiæ	Reduced to one filament more or less divided		S.-g. *Eriphyle*.
	Arborescent or pectiniform		S.-g. *Leodice*.
With branchiæ	Seven antennæ; no tentacular cirri, branchiæ cirriform		*Hyalinœcia*.
	Less than seven antennæ; with tentacular cirri		*Eunice*.
	No tentacular cirri	Five antennæ	*Marphysa* (*Nauphanta*, *Nausicæa*, *Macduffia*).
		Three antennæ	*Amphiro*.
No branchiæ	With tentacular cirri:	Five antennæ	*Nicidon*.
	Without ,, ,,	Three antennæ	*Lysidice*.
	,, ,, ,,	One antenna	*Nematonereis*.

Instead of giving numbers to the parts of the dental apparatus it has been thought more simple to give names.

Metatrachophore and Nectochæte larvæ of Eunicidæ from Naples have been described by Häcker,[2] the former having two eyes and two pairs of bristle-bundles, the latter four eyes and three pairs of bristle-bundles. He finds the Eunicid larvæ generally have a two-ringed prototroch. In the Plankton Expedition [3] he met with another Nectochæte stage with two bristle-bearing feet on each side.

Though, so far as known, no British Eunicid is phosphorescent, Mr. Cyril Crossland found that many foreign species exhibit it when killed in the dark. "The phenomenon is especially well shown, under the influence of mechanical stimulus, and in dim light, by *Eunice afra*, Peters, at Suez. The animal is strongly phosphorescent during removal from the mud, blue light being given out from points just below each parapodium (mucus-secreting pads of the ventral cirri), and a considerable amount of mucus is secreted at the same time, and this remains luminous." He mentions also that Mr. Stanley Gardiner

[1] C. Gravier, 'Nouv. Arch. Muséum,' Paris, 4 sér., t. iii, p. 217, 1900.

[2] 'Zeitschr. f. wiss. Zool.,' Bd. lxii, p. 78, 1896.

[3] 'Die pelagischen Polychæt.,' etc., p. 9, Taf. 1, fig. 2, 1898.

found the same form phosphorescent in the Maldives. *Eunice siciliensis*, which some consider a borer, is stated by Mr. Crossland also to be phosphorescent.

The distribution of the Eunicidæ is world-wide, though they are apparently most plentiful in the warmer seas. They range from tide-marks to 1240 fathoms.

Their food consists of both vegetable and animal structures—chiefly invertebrate—with sandy mud and its contents.

The majority of them secrete tubes, and some of these are branched. Others frequent holes in the limestone rocks, *e. g.*, *Eunice siciliensis*, and some on this account have been credited with the power of boring in solid, hard substances as do the Eunicids found in the telegraph cables, but, as elsewhere stated,[1] there is as yet no direct proof that they do so. Mr. Crossland has recently found both *Eunice* and *Lysidice* common in the coral blocks of the Red Sea, and perhaps may be able to clear up the ambiguity on this point.

Under this family fall the most conspicuous representatives of the "Palolos" of foreign seas. These have already been alluded to in the 'Challenger' volume[2] as well as subsequently,[3] and it need only be added in connection with the Atlantic "Palolo" that an explanation of the remarkable absence of heads is afforded by the recent observations of A. G. Mayer,[4] who found that the ripe examples of *Eunice fucata* turn tail outwards in their tunnels in the coral and limestone rock and detach the tail-end containing the reproductive elements. These swarm at the surface, and shed, as the sun rises, their ova or sperms by rupture or otherwise, whilst the shrivelled remnants fall to the bottom and perish. The adults in the tunnels regenerate their tails. In this form the males are orange posteriorly, the females greenish. Moreover *Lysidice œele*,[5] the "wawo" of Amboina, in the Malay Archipelago, leaving its retreat, swarms on the second and third nights after full moon in March and April.

The group of the Eunicidæ is one in which representatives of two divisions (*E. labidognatha* and *E. labidognatha nuda*) are found in a fossil condition in the Solenhofen slates, the genera being termed respectively *Eunicites* and *Lumbriconereites*.[6] In both instances the form of the dental apparatus considerably differs from that of the living types. These fossil forms range back to the Silurian rocks of the United States, Canada, England (Wenlock and Ludlow formations), Scotland, and Scandinavia, and a great variety of minute jaws has been described and figured by Dr. George Jennings Hinde.[7] Comparatively few examples of the maxillæ occur, the majority consisting of the great dental plates, or of the antero-lateral plates. Not a single example of the mandibles has been found, so that Mr. Hinde considers these ancient forms were devoid of them,

[1] 'Challenger,' vol. xii, Annelida, p. 262.

[2] Ibid., p. 257, 1885.

[3] 'Ann. Nat. Hist.,' ser. 7, vol. xv, p. 33, 1905.

[4] Carnegie Instit., Washington, vol. i, pp. 107—112, pl. i, 1908. A similar condition is described by Percy Moore in *Eunice paloloides* at San Diego ('Proc. Acad. Nat. Sc. Philad.,' June, 1909). Recently (April, 1910) Treadwell has found that moonlight is not necessary for the swarming of *Eunice furcata*.

[5] R. Horst, 'Mus. Harlem,' pp. 105—108, 1905.

[6] Ehlers, 'Ueb. foss. Würmer,' Cassel, 1869, and 'Zeitschr. f. wiss. Zool.,' xviii, p. 421, 1868.

[7] 'Quart. Journ. Geol. Soc.,' August, 1880, p. 368, pl. xiv; and 'Bihang till k. Svenska Vet.-Akad. Handl.,' Bd. 7, No. 5, p. 1, pls. i—iii, 1882.

and thus differed materially both from those described by Ehlers and from the living types. The persistence of these annelids (if the interpretation put on these remains is sound) is remarkable, as well as their adherence to a size akin to those of modern representatives. In some the jaws more nearly resemble those of the genus *Eunice* (*Eunicites*), in others they approach *Œnone* (*Œnonites*), in a third they are near *Arabella* (*Arabellites*), and in a fourth have the facies of those of *Lumbriconereis* (*Lumbriconereites*). It is noteworthy that in the Silurian beds the jaws have been found singly—a condition possibly due, according to Dr. Hinde, to the abundance in the same beds of Ostracoda, which may have preyed on the soft parts, and thus rendered them more readily separated by the movement of the water. The locking together, however, of the parts in certain forms would obviate such dispersion. Various irregular track-like markings were observed by Dr. Hinde on the rock-surfaces where the jaws occurred, and may have been due to the living annelids. Few instances of the occurrence of such fossils have been recorded between the Silurian and the present period. As indicated elsewhere, Ehlers is inclined to connect the foregoing structures with other phyla of the animal kingdom such as the Rotifers.

In this group are some of the giant Polychæts. Thus De Quatrefages found *Eunice Rousseaui* from Banyuls 332 mm. in length and 16 mm. in breadth. On the other hand *Ophryotrocha puerilis*, Claparède and Metschnikoff, is only a few millimetres in length, and the male is unknown. This form has been found in the body-cavity of *Cucumaria planci* at Naples, by Monticelli,[1] and *Labrorostratus parasiticus* by St. Joseph, in the body-cavity of *Eusyllis monilicornis*, *S. prolifera*, *Pionosyllis lamelligera*, and *Grubea clavata*. This shows a reduction of the maxillary apparatus, especially of the superior jaw. The same author found others amongst algæ (Rytiphlæa), so that parasitism may be temporary.

Oligognathus Bonelliæ, again, was found by Spengel in the general cavity of *Bonellia*, and in this form the inferior jaw is much reduced.[2]

Hæmatocleptes terebellidis, Wirén[3], occurs in the blood-lacuna in the wall of the stomach of *Terebellides Strœmii*. The maxillary apparatus is also reduced.

Euniceæ appear essentially to be dwellers in cracks and crevices, some especially haunting muddy fissures (*e.g.*, *Marphysa sanguinea*.) The bristles of this species and its great power enable it to adhere so firmly to its tube either by the anterior or posterior end that rupture ensues before extraction. Small twigs on the stem and branches of the Antipathidæ are modified to form a tube for these annelids (*Marphysa* and others).

Staurocephalidæ.

Eunicea prionognatha dicopa (*Ehlers*, 1868).

In this group the dorsal longitudinal muscles are lappet-shaped in transverse section, the broad ends being inferior. The ventral longitudinal muscles are massive with convex borders inferiorly. The oblique muscles pass below the nerve-cords, which have a single

[1] 'Monitore Zoolog. Italiana,' Fierenze, 1892, No. 12, p. 250.

[2] 'Mitth. Zool. Stat. Neap.,' 3e Bd., 1882, pp. 15—52, Taf. ii—iv.

[3] 'Bihang till K. Sv. Akad. Handl.,' Bd. xi, No. 12, 2 pls., 1886.

neural canal median in position between the cords, dorsal at the ganglia, and occasionally a small one is seen at the side as if from a branch. The cords are comparatively large.

Grube first established the genus *Staurocephalus* for the common species *S. rubrovittatus* from Trieste. He afterwards constituted the genus *Anisoceros* for certain foreign species, which further examination proved to fall under the former genus, and consequently this lapsed. In his final publication on the group (1879) he arranged them according to the presence or absence of a terminal segment to the subtentacle and the proportionate length of the latter, the condition of the dorsal cirrus, tentacles, and anterior segments, the eyes and other features being of service in arranging the sub-divisions.

Kinberg[1] placed this group in the fourth division of his Eunicea, and distinguished it as having the mandibles split, the maxillary series short, and the posterior appendages of the maxillæ short. The family itself (Staurocephalea) was characterized by the numerous maxillæ, the fourth series being toothed and touching laterally.

De Quatrefages (1865) included *Prionognathus* as one of the genera of his Syllids, the type being *P. ciliatus*, Keferstein, whilst *Staurocephalus* was placed under genera and species of uncertain position. He thought that the presence of a fine bristle in the dorsal cirrus of *Staurocephalus rubrovittatus* indicated a bifid condition of the foot, but Claparède argues that the same occurs in *Sacconereis helgolandica*, Fritz Müller, in *Sigambra Grubei*, in *Eunice tænia*, and in *Psamathe*, and therefore thinks its importance exaggerated.

Claparède (1868) observes that Grube, in his Annulata Œrstediana, constituted the genus *Anisoceras* for several foreign species which he considered different from *Staurocephalus* already established. But after a study of *Anisoceras rubrovittatus* he changed the title, making *Anisoceras* a sub-genus. Unaware of Grube's observations, Keferstein in 1862 made a new genus, *Prionognathus*, for the same type. Fritz Müller again pointed out the close relationship of the genus with the Eunicidæ, and Keferstein's view corresponded, though he linked them also with the abnormal Syllideans.

The same author (1868) found a dorsal, two lateral and a ventral vessel in *S. Chiaji*, and complex plexuses in the feet, cirri, and tentacles. The lateral and dorsal vessels send forward, the ventral backward currents.

Levinsen (1883), after Kinberg, grouped the Staurocephalidæ as the last of the first section of his Euniciformia, viz., the *E. vera*, those preceding being the Eunicidæ, Onuphidæ, and Lumbrinereidæ. It may be presumed that Benham includes the group under his Eunicidæ, the tenth family of his Nereidiformia, having in front the Amphinomidæ and in rear the Glyceridæ, a classification which evoked the criticism of Miss Florence Buchanan, who rightly objected to the author separating *Polydora* from the Spionidæ as an independent family while assimilating the Staurocephalidæ with the Eunicidæ and placing *Spinther*, *Euphrosyne*, and *Amphinome* under one family.

Gravier (1900) considers, after Pruvot and Racovitza, that the Staurocephalidæ are a more primitive type than the Lumbriconereidæ.

Claparède and Mecznikow[2] (1869) describe a young stage of *Staurocephalus Chiaji*,

[1] Öfvers. Kongl. vet.-Akad. Förhandl., 1864, p. 574.

[2] 'Zeitschr. f. wiss. Zool.,' Bd. xix, p. 186, Taf. xv, fig. 3.

Clprd., from Naples, measuring 0·8 mm., of nine segments, four of which had cirri (branchiæ). The snout is hoof-shaped, with two eyes, the tentacles arising immediately behind them. Nuchal grooves occur at the posterior edge on each side, and a dental apparatus is developed. The foot is fairly formed and the dorsal cirrus is articulated.

Genus LXI.—Staurocephalus, *Grube*, 1855.

Anisoceras, Grube. *Prionognathus*, Keferstein.

Head rounded, quadrangular or pentagonal, with two articulated tentacles, two palpi, and four eyes. Nuchal organs primitive, ciliated surfaces in direct contact with the exterior (Racovitza). Two segments devoid of appendages. Body with comparatively few segments. Pygidium with two shorter and two longer cirri.

Upper jaw with two rows of jaw-plates, the wide halves of the mandible diverging posteriorly into narrower processes.

Foot long, bifid, the upper division with simple bristles, the lower with compound bristles. Dorsal cirri unequal with a short terminal process. Ventral cirrus arising from the foot, short and simple.

In transverse section the body-wall (Fig. 76) has somewhat thin dorsal muscles,

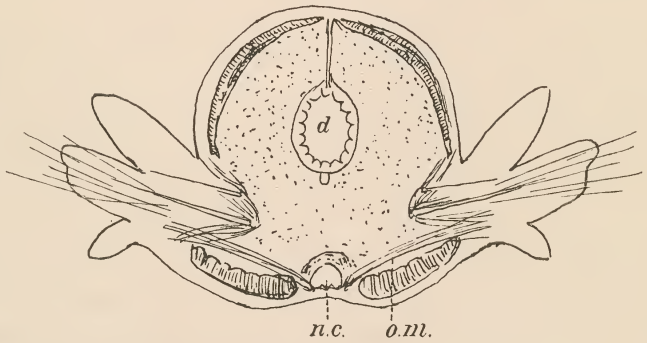


Fig. 76.—Transverse section of a nearly ripe male of *Staurocephalus rubrovittatus*. The cœlom is much distended. *d*. Alimentary canal. *n.c.* Nerve-cord. *o.m.* Oblique muscles.

but the ventral are more massive in proportion. The ventral nerve-area is large, and the oblique muscles pass downward to be inserted at its sides. At the reproductive season, as in the section figured, the sexual elements largely distend the cœlom, and the muscular layers undergo more or less atrophy.

One of the most interesting features in the genus is the occurrence of pelagic "swarming" in a species (*Staurocephalus gregaricus*) from the Tortugas Islands, Florida, as described by A. G. Mayer.[1] The entire worms leave the coral rocks, swim at the surface, and discharge the sexual products soon after sunrise, *e.g.*, on July 19th, when the last quarter of the moon falls on July 18th. The author also gives figures of the eggs and larvæ.

Grube's first group contains those in which the palpi (his sub-tentacles) have no terminal segment. It includes the common British species.

[1] A. G. Mayer, 'Bull. Mus. Comp. Zool.,' Harvard Coll., vol. xxxvi, No. 1, 1900.

1. Staurocephalus rubrovittatus, *Grube*, 1855. Plate LV, fig. 1; Plate LXI, figs. 7–7 *c*—teeth; Plate LXXIII, figs. 4–4 *a*—feet; Plate LXXXI, figs. 9 and 9 *a*—bristles.

Specific Characters.—Head somewhat rectangular, with four brownish-black eyes, the anterior considerably larger than the posterior and wider apart. Two short clavate (four-ringed, Grube) tentacles arise between the eyes of each side, and extend nearly to the anterior edge of the snout. Two curved or sickle-shaped thick palpi (sub-tentacles, Grube) spring below the snout. A slight fillet occurs on each side of the head posteriorly. Head and appendages pale.

Body somewhat fusiform, with fifty-three or more bristled segments, tapered from the anterior third forward, and from rather more than the posterior third backward to the tail, which ends in two short cirri, two longer being in front of them (Ehlers). First two segments devoid of feet. The first is fine rose-red, the second is paler. Two bars of the same colour on each segment. Ground-tint of the body is flesh or cream-coloured. The mouth has two lips. The dorsal dental apparatus consists of a double row of horny teeth which are pinnate, the median fang of the dorsal series in front being prolonged into a slender process. The lower row is the stronger, is dark brown, and has about twenty to twenty-one teeth.[1] The upper row has ten to twelve teeth which are well developed. The mandibles are club or wedge-shaped, the broad anterior edge being coarsely crenate. The foot has a stout dorsal cirrus with a terminal articulation which projects beyond the tip of the setigerous region. A slender spine occupies its middle. Setigerous lobe large, dorsal ridge ciliated, and the free border split superiorly into two conical processes, and with convex edges inferiorly. The ventral lobe projects beyond the adjoining part of the setigerous lobe. A single translucent spine is present. The upper bristles are transparent, gently widening upward and forming a flattened blade with a serrated edge. Lower bristles equally translucent, curved, dilating at the distal end of the shaft, which is bevelled, and articulates with a bifid terminal piece, the secondary process being separated by a considerable interval from the terminal hook.

Synonyms.

1855. *Staurocephalus rubrovittatus,* Grube. Arch. f. Naturges., xxi, p. 97, Taf. iii, f. 9.
1860. „ „ idem. Ibid., xxvi, p. 78.
1861. „ „ idem. Ausflug nach Triest, pp. 24 and 140, pl. 1, f. 10 and 11.
1864. „ „ idem. Die Insel Lussin, p. 80.
1865. „ *erucæformis,* Malmgren. Nord. Hafs-Annul., p. 184.
„ „ *rubrovittatus,* De Quatrefages. Annel., ii, p. 83.
1866. *Dorvillea lobata,* Parfitt. Zoologist, 2nd ser., vol. i, p. 113.
1867. „ „ idem. Trans. Devon Assoc., ii, p. 23 (sep. copy).
„ *Staurocephalus erucæformis,* Malmgren. Annul. Polych., p. 62, Taf. viii, f. 50.
1868. *Staurocephalus erucæformis,* Ehlers. Borstenw., p. 424, pl. xviii, f. 1—16.
1875. „ *rubrovittatus,* Marion and Bobretzky. Ann. Sc. nat., 6e sér., tome ii, p. 10.
1879. „ *erucæformis,* Langerhans. Zeitschr. f. wiss. Zool., xxiii, p. 299.
1885. „ *rubrovittatus,* Pruvot. Arch. Zool. expér., 2e sér., t. iii, p. 274, pl. xi, f. 4; pl. xii, f. 10—13.

[1] Grube gives twenty-eight and twenty-one respectively.

1885.	*Staurocephalus rubrovittatus,*	Carus.	Fauna Medit., p. 217.
1888.	,,	,,	De St. Joseph. Ann. Sc. Nat., 7e sér., t. v, p. 235, pl. x, f. 99.
1895.	,,	,,	Pruvot and Racovitza. Annel. Banyuls, in Arch. Zool. expér., 3e sér., vol. iii, p. 349, pl. xv.
1902.	,,	,,	McIntosh. Ann. Nat. Hist., ser. 7, vol. x, p. 257.
,,	,,	,,	Marenzeller. Polych. Grund., p. 15.
1904.	,,	,,	Allen. Journ. M. B. A., N.S., vol. vii, p. 226.
1905.	,,	,,	Graeffe. Arbeit. Zool. Stat. Triest, xv, p. 322.
1906.	,,	,,	De St. Joseph. Ann. Sc. Nat., 9e sér., t. iii, p. 215.

Habitat.—The under surfaces of stones near low-water mark, and the larger stones in pools at Herm (A. and R. M.), Devonshire (Col. Montagu), Plymouth (Allen).

Extends to the Mediterranean and the continental side of the Channel. Grube first procured it in the Adriatic, Pruvot found it common in tufts of *Cystoseira* at Roscoff. Apparently the same form is mentioned by Malmgren from deep water in Finmark.

Head (Plate LV, fig. 1) somewhat rectangular, with four brownish-black eyes, the anterior pair considerably larger (though hidden by the tentacles in the figure) than the posterior, and wider apart. Two short clavate tentacles spring between the eyes of each side, and extend nearly to the anterior edge of the snout.[1] Two curved or sickle-shaped thick palpi arise below the snout and project on each side like horns. A slight ciliated fillet is indicated on each side of the head posteriorly.[2] Head and appendages pale, with palpocils on the anterior border (Pruvot and Racovitza).

Body of fifty-three or fifty-four bristled segments, and fully an inch long (15—29 mm. Pruvot and Racovitza), somewhat fusiform, slightly tapered from the anterior third forward, and from rather more than the posterior third backward, and terminating in a moderately tapered tail with two short cirri and a dorsal anus. The first segment has no foot and is broader than the second. It is tinted of a fine rose-red, the "organs nucaux" of Pruvot and Racovitza, which are developments of the anterior border of the first segment, are innervated by the posterior lobe of the cephalic ganglia. The second is paler, and also is devoid of feet. Bands of the same rose-red hue cross the body from the anterior to the posterior end, being fainter in front and behind. Each segment has two bands which cross the anterior and posterior parts (with a pale belt between), diminishing to a point before reaching the bases of the feet. The tint of each posterior band is somewhat deeper. The feet and cirri, with the ground-tint of the body, are flesh or cream-coloured.

The upper dental apparatus consists of two rows of dark brown horny teeth, the inferior and inner (Plate LXI, fig. 7) being the stronger. This row commences anteriorly in an irregularly differentiated horny band, which soon rises into distinct teeth separated from each other, and of a complex nature. Twenty-one teeth on one side and twenty on the other are visible in this part of the apparatus. These teeth (Plate LXI, fig. 7 *a*), like

[1] Ehlers represents four articulations in his examples, but those procured in Herm, whether imperfect or otherwise, were as described and as Pruvot and Racovitza state. In *S. Chiaji,* Claparède, there are six segments.

[2] In the *S. Chiaji* of Claparède two ciliated pits, supposed to be sensory, occur at the posterior border of the head; and two other vibratile pits are present inferiorly at the sides.

those of the upper (outer) row, conform to the same type, though variously modified. They are split at the base into two flattened plates which lie on each side of a lingual band, and give attachment to the muscles moving the tooth. The median tooth is powerful, and, in the drawing, is by no means acute, having apparently been in active use. On each side are four smaller teeth, the last being minute and often obscured when *in situ*. They extend along the ridge in a somewhat intricate manner, the teeth having the longest processes being in front of the middle of the row, whilst the posterior teeth are more compact and their processes smaller. The curve at the tip is also more decided. The last tooth abuts on a long serrated horny band, the crenations or teeth being much larger than those on the corresponding portion of the outer and upper row.

The outer and upper row has ten or twelve distinctly developed teeth (Plate LXI, fig. 7 *b*). They also occupy a ridge clasped by the bifid base, each lamella of which is somewhat expanded at the tip. A few anteriorly are small, but they soon show an elongated median tooth which projects into the pharynx like a spine slightly bent toward the tip. About five have the long median process, though several of those succeeding have a tendency to the same condition. These teeth diminish posteriorly, sometimes with an irregular mass or two, and then end in a long bar with a finely denticulated edge.

This apparatus evidently is of importance in feeding, the more powerful lower row performing the sections, whilst the more slender upper series probably aid in holding or manipulating the morsels, the long horny processes especially being useful in this respect.

The external rows of rudimentary teeth indicated by Ehlers either were not present or had been overlooked in the dissection. These small teeth form a single row beginning externally rather in front of the middle, and continuing backward to the commencement of the posterior bar, when two rows occur, a shorter inner and a longer outer.

The mandibles are club- or wedge-shaped, broad in front and tapering to a point posteriorly. The broad anterior border (Plate LXI, fig 7 *c*) is coarsely crenate at the outer edge, but very finely denticulated on its inner edge anteriorly. The two mandibles project beyond the lower lip in some preparations.

The alimentary canal contains fragments of Crustacea, sand-grains, spicules of sponges, and other *débris*.

The minute first foot presents three pointed lobes, a single pale spine and a group of bristles. Two of the lobes are superior, one bearing the spine, and below it the bristles, which have jointed bifid tips and dilated ends of the shafts with bevelled edges. The other is the ventral cirrus.

The feet gradually increase in size, so that at the fourth or fifth there is dorsally a thick cirrus, with a conical articulation at the tip (cirrophore and cirrostyle, Pruvot and Racovitza), and internally two slender spines which pass almost to the tip of the organ. Beneath are a trifid setigerous lobe—the pale spine passing between the upper divisions—and also the simple bristles, which are slightly curved toward the somewhat blunt end and finely serrated on the upper or convex edge. Along the lower edge of the furrow of the trifid region is the dense group of the translucent jointed bristles, the shafts having dilated and bevelled ends and bifid terminal pieces. The ventral lobe of this division is broadly lanceolate.

The typical condition of the foot is assumed about the tenth and subsequent feet (Plate LXXIII, fig. 4) toward the middle of the body. Dorsally is the stout dorsal cirrus with the terminal articulation, its tip projecting considerably beyond the soft parts of the foot beneath. The slender spine occurs internally as in the foregoing foot. Claparède[1] describes the basal segment as having four parallel blood-vessels, which do not enter the terminal piece, but anastomose with each other. He considers this the homologue of the short ceratophore of the majority of Annelids. The setigerous lobe is large and strong, its dorsal ridge richly ciliated, and the free border split into two conical processes superiorly and convex edges inferiorly. The ventral cirrus projects beyond the adjoining part of the setigerous lobe. The bristles of the dorsal part of the setigerous lobe (Plate LXXXI, fig. 9) are transparent and elongated, gently widening upward and forming a flattened blade with a finely serrated edge, the tip being curved and ending in a slightly tapered point. Some of the bristles have a broader and shorter flattened region at the tip than that figured. The serrations are elevated distally. Pruvot and Racovitza describe them as having an irregular border. The bristles of the inferior group are more numerous, but equally transparent, the shaft dilating into a somewhat large distal region, which is bevelled and carries the rather elongated and minutely serrated terminal piece, which is bifid (Plate LXXXI, fig. 9 *a*), the terminal hook being separated by a considerable interval from the secondary process, and thus characteristically differing from such types as *Staurocephalus Rudolphii*, from Naples, a form in which the secondary process passes distally like a knife-blade and touches the terminal hook.

The presence of a spine in the dorsal cirrus, so called, raises the question as to the composition of such a foot, De Quatrefages interpreting it as an indication of a dorsal division, whilst Claparède thought differently.

The feet retain the same structure to the posterior end of the animal, but they diminish in size as in front. Claparède showed that the feet discharge many bacillary bodies from follicles.

In an example caught in a tow-net off Sark by Mrs. Collings in June, 1869, and measuring about three quarters of an inch, the feet (Plate LXXIII, fig. 4 *a*) differed considerably from those of the foregoing ripe male. Thus the dorsal cirrus was less massive, the inferior processes of the setigerous region were more acute in lateral view, and the bristles, both simple and compound, were more attenuated. The terminal pieces of these, however, maintained the character of the species, the terminal hook and the secondary process being separated by a considerable curved interval, though the process was somewhat shorter (Plate LXXXI, fig. 9 *b*).

Reproduction.—Most of the examples procured in July at Herm were males in which the body-cavity was distended with sperms. These also invaded the feet, almost to the tip, and a column of them passed along the centre of the dorsal cirrus. Pruvot and Racovitza give July as the breeding period, and add that most of the young have a single pigment-band on each segment. In transverse section the body of the male shows greatly stretched muscular layers, whilst the alimentary canal forms an elliptical central slit, apparently without food.

[1] 'Annél. Chèt. Nap.,' i, p. 118, pl. vii, fig. 2 B, *f*.

The segmental organs in this form are visible as transparent objects in the young examples (Fage[1]). The external aperture is placed above the glandular epidermic pad at the base of the foot.

Habits.—It is active like a *Hesione* and appears to be tolerably hardy. De St. Joseph states that it secretes much mucus. Eisig[2] describes the Neapolitan form, *S. Rudolphii*, D. Ch., as swimming freely in an undulating manner, and performing various movements even after decapitation.

It is possible that further examination may reveal a closer approach between this and allied forms such as Delle Chiaje's species named by Claparède *S. Chiaji*. Moreover the *Nereis Rudolphii* of Delle Chiaje[3] appears to be the present species. In the 'Descrizione' it is termed *Syllis Rudolphiana*.[4]

In Montagu's MS. volume of drawings (1808) in the Linnean Society is a figure of this species (Plate XLVII, fig. 1), named *Nereis pennata*, and with "*Dorvillea lobata*" pencilled opposite. The proboscis is thrust out and coloured pink. Only two eyes are represented. It is clear, therefore, that Col. Montagu was the first naturalist who procured the species.

This is one of the numerous species the accurate description of which science owes to the indefatigable exertions—continued throughout a long life—of Prof. Ed. Grube, of Breslau, who found it in 1855 in the Adriatic at Triest, Fiuma, and Cherso. An amended description, generic and specific, was published a few years later (1860). He held the foot to be uniramous, and the blood red. Grube also pointed out its differences from *Anisoceras vittata*, *rubra*, and *bioculata*, Grube and Œrsted.

Pruvot agrees with Ehlers in considering the inferior appendages of the head to be palpi. He found the nervous system of this species conform to the type in the Eunicidæ.

Pruvot and Racovitza[5] describe the first segment as having four red bands. Moreover they mention two varieties, viz., those with the two bands on each segment, which are commonly dredged and which secrete a tube of mucus, and the variety with one band which inhabits dead colonies of *Dendrophyllia* and *Amphihelia* and also occurs amongst Serpulæ. The authors give an elaborate description of the structure of the foot and of the proboscis and its armature.

The accurate comparison of the American forms of this group has yet to be carried out, and the connection between such species as the *Staurocephalus pallidus* of Verrill, and *S. sociabilis* of Webster, from the American shores, and the British forms, may be closer than is at present supposed.

The following fall under Grube's second main division in which the palpi are jointed, whilst the dorsal cirri are very short and without an articulation, or absent.

[1] 'Ann. Sc. nat.,' 9e sér., iii, p. 349, 1906.
[2] 'Fauna u. Fl. Neap.,' xxviii, p. 211, 1906.
[3] 'Mem.,' iii, pp. 166, 176, Tav. xliii, figs. 13, 14, 19.
[4] T. iii, p. 95.
[5] 'Arch. Zool. expér.,' 3e ser., vol. iii, pp. 349—373, pl. xv, 1895.

2. Staurocephalus Kefersteini, *McIntosh*, 1869. Plate LV, fig. 2; Plate LXI, fig. 8—teeth; Plate LXXIII, fig. 5—feet; Plate LXXXI, figs. 10–10 *b*—bristles.

Specific Characters.—Head bluntly conical; eyes two, black, at its posterior border. A moniliform tentacle springs from the outer side of each eye; palpi long with terminal articulation. Body slender, elongate, terminating in two articulated cirri. First of the two naked segments the broader. Colour orange, with pale head, tail, and feet. Proboscis with a double row of teeth as in *S. rubrovittatus*, but smaller. Lower and inner row of dark brown curved teeth with a median and one or two lateral points, with lateral wings. Inferiorly it terminates in a long process with alternately large and small teeth. Outer and upper row consists of amber-coloured teeth of similar but more slender form. Toward the lower end more than one small tooth intervenes between the longer. Mandibles brownish-black, clavate, and with about five denticulations on the edge. Foot when fully developed stout, with ovate dorsal lobe. Setigerous region with a single pale spine at the base and a few stout, straight, translucent bristles, the shaft being dilated and then bifid at the end, one end having a claw, the other being simply pointed. Below are a few slender bristles with straight shafts and curved tapered tips which are finely serrate. Beneath the spine are five or six bristles with curved shafts dilated at the end, and with a few serrations, and terminal pieces which vary from above downward. The tips of the latter are really bifid.

Synonyms.

1869. *Staurocephalus Kefersteini*, McIntosh. Trans. R. Soc. Edin., xxv, pt. ii, p. 417, pl. xvi, f. 11 *a–g*.
1879. „ „ Grube. Jahresb. Schles. Gesellsch., p. 112.
1895. „ „ Pruvot and Racovitza. Arch. Zool. expér., 3e sér., vol. iii, p. 372.
1902. „ „ McIntosh. Ann. Nat. Hist. ser. 7, vol. x, p. 257.

Habitat.—Under stones near low-water mark on both eastern and western shores of North Uist, Outer Hebrides. One occurred in an old tube of *Serpula* and another was dredged in Loch Portan (an inland sea more or less brackish) in three to four fathoms.

Head (Plate LV, fig. 2) conical, snout rounded, forming the blunt apex of the cone. Eyes two, of moderate size, black, situated toward the posterior border of the head. A tentacle springs from the outer side of each eye, and is annulated or moniliform. They seem to be about as long as the diameter of the head in life. The palpi arise from the infero-lateral region of the head, have a short terminal articulation, marked off by a constriction, and are proportionally long. They are often coiled and twisted in a graceful manner, and both they and the tentacles are pale.

Body slender, elongated, composed of many segments, and terminating posteriorly in two pale articulated cirri of moderate length and with two shorter cirri in front of them, shorter than in Keferstein's *S. ciliatus*. In general outline it resembles a *Syllis*, and is about an inch in length. Colour orange, paler at head and tail, the feet being also pale. The orange band on the dorsum curves inward opposite each foot, and slightly outward at each segment-junction. Two reddish lines proceed backward from the head and appear to be due to vessels, as waves passed from behind forward. In the example from Loch Portan a faintly marked dark bar occurred at the posterior part of each

segment on each side of the intestine. The first two segments are devoid of feet, and in the preparation the anterior seems to be the broader.

The proboscis is armed with a double row of teeth as in *Staurocephalus rubrovittatus*, but from the diminished size of the animal they are proportionally smaller. The lower and inner row consists of dark brown strongly curved teeth with a median and one or two lateral points, with the basal wings for support. Each terminates inferiorly in a long process, which has alternately large and small teeth. The outer and upper row consists of amber-coloured teeth of similar but more slender form and terminating inferiorly in a similar process with smaller sharp teeth alternately larger and smaller. Towards the lower end more than one small tooth intervenes between the larger.

The mandibles are clavate and of a brownish-black colour. The free edge is coarsely denticulated (Plate LXI, fig. 8), about five teeth occupying the edge, the last or outer with an accessory process.

The anterior feet are smaller and somewhat rudimentary, but when fully developed (Plate LXXIII, fig. 5) have a stout form, and a somewhat ovate or ovato-lanceolate dorsal lobe narrowed at its attachment and projecting above the large setigerous region. This has superiorly a single pale spine, the point of which just touches the surface. Above the spine are one or two stout, straight, translucent bristles, the shaft of which dilates and is bifid at the end (Plate LXXXI, fig. 10), the longer limb of the fork slightly flattened and with a claw at the tip. The other is simply pointed. Below these are one or two slender bristles with straight shafts and finely tapered tips which are definitely curved and finely serrated from a little below the bend—upward along the tip on the convex side of the curve—which is usually directed dorsally (Plate LXXXI, fig. 10 *a*). The bristles beneath the spine are generally five or six in number, translucent with curved shafts, dilated at the end, and with a few serrations (the convexity being directed dorsally), and terminal pieces which form a diminishing series from above downward, the upper being the longest and the lower the shortest (Plate LXXXI, fig. 10 *b*). The tip of the terminal piece, at first thought to have a simple hook, is really bifid, for close to the terminal hook a minute secondary process is present. The setigerous region is produced outward inferiorly into a prominent papilla at the origin of the inferior bristles. The terminal pieces do not show serrations on the edge in the preparations, but they may have had them when fresh. The ventral lobe arises nearer the body than the dorsal, but has a similar shape, the base being narrowed at its attachment to the foot.

The example from which the drawings were made was a female with small eggs showing nucleus and nucleolus in August.

Habits.—They often twist themselves into a circular ball, crawl about frequently on their sides with a wriggling motion, and can also swim in a similar manner. They are on the whole active and lively.

3. Staurocephalus ciliatus *var.* Robertianæ. Plate LXI, figs. 9 and 9 *a*—teeth; Plate LXXIII, fig. 6—foot; Plate LXXXI, figs. 11–11 *b*—bristles.

Specific Characters.—Head flattened and tapered anteriorly to a blunt snout. Eyes two, large, black. Palpi arising laterally in front of the eyes and having a terminal arti-

culation. Tentacles moniliform, scarcely half as long, much smaller in diameter than the palpi, and springing from the dorsum of the head behind the eyes. Body about one inch long, pale lavender, a yellow belt bounded by a red line on each side along the centre, slightly tapered in front and more definitely diminished posteriorly, where it ends in two caudal cirri. Proboscis has in the lower row a dense series of curved dark brown denticles with a median and two lateral teeth, the maximum development occurring toward the posterior third, and terminating in a thickened dark brown band with irregular denticles. Upper row begins anteriorly in a series of pale brown horny filaments which merge into the long teeth of the row. Posteriorly they diminish in length, but increase in robustness, and terminate in a band of small denticles. An accessory row externally on each side. Mandibles shaped like a boomerang, with a series of eight deeply cut teeth on the anterior edge, besides three separate denticles externally. Feet generally uniform, distinguished by a well-developed dorsal cirrus, which commences on the second foot, containing a slender spine which goes as far as the articulation of the considerable terminal process. Setigerous region large, bevelled superiorly, and trending to the prominent inferior border. The obovate ventral cirrus projects beyond it, less, however, than the dorsal cirrus. Two kinds of bristles superiorly, viz., a long slender translucent form with an abrupt curve below the serrations and a finely tapered tip, and a stronger bristle or two with a straight shaft and a dilated, bifid extremity, one of the legs of the fork being shorter, broader, and more acute at the tip. The inferior bristles compound, with curved shafts, and dilated, bevelled, and serrated distal ends. Terminal piece with a bifid tip.

Synonyms.

1862. *Prionognathus ciliatus,* Keferstein. Zeitschr. f. wiss. Zool., Bd. xii, p. 99, Taf. viii,. f. 13—19.
1885. *Staurocephalus Chiajei,* Carus. Fauna Medit., p. 217.
1902. „ (third), McIntosh. Ann. Nat. Hist., ser. 7, vol. x, p. 257.
„ „ (fourth), idem. Ibid., ser. 7, vol. x, p. 257.
1904. „ *ciliatus,* Allen. Journ. M. B. A., N.S., vol. vii, p. 226.

Habitat.—Under stones between tide-marks, St. Peter Port, Guernsey, July, 1868 (W. C. M.); Plymouth (Allen).

Head flattened and tapered anteriorly to a blunt snout. Eyes two, black, large and distinct. Palpi arising from the sides of the snout in front of the eyes and having a terminal articulation. Tentacles, scarcely half the length and much smaller in diameter than the palpi, springing from the dorsum of the head behind the eyes, and moniliform throughout.

Body upwards of an inch long (25—30 mm., Keferstein), of a pale lavender hue, marked along the centre of the dorsum by a yellow belt, bounded on each side by a red line, probably from the blood-vessels. It is slightly tapered in front and more definitely so posteriorly, where it ends in two caudal cirri. Segments numerous, the first and second being devoid of feet. When preserved the feet of the anterior fifth are crowded, those behind are less so.

Proboscis.—In this and allied forms the food first comes under the action of the serrated edges of the mandibles, and is then passed inward (upward) to the double

row of hard horny points which guard each side of the pharyngeal slit. The elaborate series of muscles which move these denticles, and their conformation, denote important functions. In this species (Plate LXI, fig. 9) the lower row has a dense series of strongly curved dark brown denticles with a median and two or three lateral teeth. They have their maximum development toward the posterior third of the row, whereas in front they form a comparatively even series of smaller and less dusky teeth. Posteriorly the row terminates in a thickened dark brown band with irregular denticles. The upper row commences anteriorly in what seems to be a series of pale brown horny filaments which merge into the somewhat long teeth of the row, the curves of which, like those of the lower row, are directed backward. Posteriorly the teeth diminish in length but increase in robustness, and have toward the inferior end a brown hue as deep as that of the lower row. The row terminates in a band of small denticles. Besides these rows a less developed accessory row occurs to the outer side of them, and on one side a similar row on the inner side. Ehlers shows a similar accessory row in *Staurocephalus rubrovittatus*.

The mandibles (Plate LXI, fig. 9 *a*) are shaped somewhat like a boomerang, and have on the produced anterior edge a series of eight deeply-cut teeth, besides three separate denticles at the outer edge.

The nerve-cords in the preparations are flattened in transverse section, but such may be due to the methods of preparation.

The feet of this form are distinguished from those of the Hebridean species by the presence of a well-developed dorsal cirrus, which appears on the second foot. At the twentieth foot (Plate LXXIII, fig. 6) the parts have attained an average outline and structure. Dorsally is the stout cirrus with a slender central spine proceeding as far as the articulation of the terminal process, which is, proportionally, of considerable length. The setigerous region is large, bevelled superiorly, the outline in lateral view trending to the prominent inferior border whence the compound bristles arise. This prominent region attains even greater development posteriorly. Inferiorly, at some distance from the edge, the obovate ventral lobe projects outward beyond the setigerous region, less, however, than does the dorsal cirrus.

Superiorly two bristles occur, viz. (Plate LXXXI, fig. 11), a long, slender, translucent bristle with a somewhat abrupt curve below the serrations and a finely tapered tip, on the slender terminal region of which the serrations become indistinct. They are directed distally, and are most distinct inferiorly. Accompanying this is a stronger translucent bristle (or two) with a straight shaft and a dilated, bifid extremity (Plate LXXXI, fig. 11 *a*), one of the legs of the fork being shorter, broader, and more acute at the tip, the other less expanded and longer. Traces of two spines occur on the edge beneath. The inferior group consists of compound bristles (Plate LXXXI, fig. 11 *b* and *b'*) with translucent shafts, curved, with the convexity upward, and dilated and bevelled distal ends which are also serrated. The terminal piece, as usual, varies in length, diminishing from the upper to the lower bristles, one of the shorter being represented in the figure. The tip is bifid, a secondary process passing forward nearly parallel with the axis of the terminal piece to the distal hook, and thus differing from such as have the secondary process projecting at a larger angle.

The feet do not alter materially in character posteriorly, except that the lower part of the setigerous process at the exit of the inferior bristles is more prominent.

Reproduction.—The specimen is a female, with comparatively early ova (July). On the other hand an example from Plymouth, kindly sent by Dr. Allen, had fairly developed ova in June.

This species approaches Keferstein's *Prionognathus ciliatus*, and it may be that the differences are due to imperfections in description and figures. The additional pair of small eyes behind the tentacles is a marked distinction, though variation may occur in this respect, yet in colour, structure of feet, bristles, and other parts, it closely corresponds. The description of the teeth, however, differs, and he figures the ventral bristles as having a simple instead of a bifid tip. Moreover, Grube places weight on the occurrence of only two eyes, which is the condition, for instance, in his *S. bioculatus* from Costa Rica.

This appears to be distinguished from Claparède's *S. Chiaji* by the presence of only two eyes, by the much longer palpi, and the shorter tentacles, by the absence of the dorsal peristomial papillæ, by the absence of the elongated spines on the simple bristles, by the absence of boldly serrate compound bristles, and in other particulars.

So far as can be observed the *Staurocephalus pallidus* of Langerhans[1] approaches closely to *S. ciliatus*, Keferstein, and this conclusion is borne out by an examination of an example from Plymouth, kindly sent by Dr. Allen. The example has two very distinct eyes at the inner border of the tentacles.

Claparède and Mecznikow[2] describe and figure a young example of the allied *Staurocephalus Chiaji*, 0·8 mm. long, with two projecting lateral lappets of the prostomium, and a pair of unjointed tentacles with palpocils at the tip. The dental apparatus is present, and there are two dorsal organs on the peristomial segment. The feet are fairly formed with a jointed dorsal cirrus.

Another form, which may be termed provisionally *Staurocephalus* B, requires a brief notice :—

Habitat.—Procured in a trammel net off Fermain Bay, Guernsey, in July, 1868. The net was placed at a considerable depth—near the bottom.

Head furnished with four red eyes, and probably having the typical structure, though such was not observed in the example, which was injured.

Body elongated as in *Staurocephalus Kefersteini*, and of a pale yellow hue, brownish from the intestine, posteriorly. A line of white pigment passes along the middle of the dorsum from the proboscis backward. Posteriorly the line becomes double from an intervening streak and disappears towards the tip of the tail.

The feet closely agree with those of *Staurocephalus Kefersteini* in regard to general outline, the proportions of the dorsal and ventral lobes (the latter being somewhat smaller and more elongate), and the structure of the bristles. The compound series inferiorly show the same very minute secondary tooth below the distal hook. The bifid bristles of the upper part of the setigerous process are identical, the only difference observed being the absence of the curve in the slender tapering bristles of the upper series,

[1] 'Zeitschr. f. wiss. Zool.,' xxxiii, p. 300, Taf. xvi, fig. 35, 1869.

[2] Ibid., xix, sep. abd., p. 24, Taf. xv, fig. 3.

and the absence of serrations. The great length, straightness, and slenderness of the dorsal bristles may be connected with a sexual change associated with the largely developed ova.

The example is a female laden with large ova, each of which has its longer diameter exceeding the vertical diameter of the foot.

Unfortunately the head and anterior region were injured, so that considerable doubt must remain. It differs from *Staurocephalus pallidus*, Langerhans, in the presence of four eyes, and in the structure of the bristles.

4. Staurocephalus pallidus, *Langerhans*, 1879. Plate LXXXVII, fig. 9—head, 9 *a*—foot; Plate LXXXVI, figs. 10, 10 *a*, and 10 *b*—bristles.

Specific Characters.—Head with only two eyes; tentacles nine to ten, ringed, and longer than the two-jointed palpi. No nuchal grooves. Body 1 cm. long, with fifty segments. First two without feet and third without a dorsal cirrus. Anal segment with two longer jointed dorsal and two smaller simple ventral cirri. Lower jaw with from seven to ten teeth on either side, and three to five free denticles. Upper jaw as in other species, only with two rows of teeth without accessory jaws. The plate of the upper row has about twenty-five teeth, simple in front but posteriorly denticulated. That of the lower jaw is a thin toothed leaf, having smooth upper but denticulated lower teeth. Foot as long as breadth of body; dorsal bristles simple, serrated, or with a distal process; in the fourth segment simple, serrated; twelfth segment with long simple tips above the serrated edge; in the thirteenth segment stout bifid forms. Inferior division has compound bristles, the terminal process having a hook distally and a process beneath (Langerhans).

Synonyms.

1879. *Staurocephalus pallidus*, Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxiii, p. 300, Taf. xvi, f. 35.
1904. „ „ Allen. Journ. M. B. A., n.s., vol. viii, p. 226.

Habitat.—Dredged on Asia shore, Plymouth (Allen).

Head (Plate LXXXVII, fig. 9) with only two eyes; tentacles with nine double rings, longer than the bi-articulate palpi. No nuchal grooves observed.

Body about 1 cm. in length (Langerhans), and having fifty-nine segments. The first two segments are devoid of bristles, and the third has no dorsal cirrus, which, as a two-jointed structure, appears on the fourth. Anal segment with four cirri, two longer jointed dorsal cirri, and two smaller simple cirri ventrally.

Lower jaws armed with seven to ten teeth on either side, and three to five denticles. Upper jaw as in other species, only with two rows of teeth, without secondary jaws. The plate of the upper row is compact, with about twenty-five teeth which are more simple in front, but posteriorly denticulated. The plate of the lower jaw is a thin, toothed leaf, with smooth teeth in the upper but denticulated teeth in the lower row.

Foot as long as the breadth of the body, with the bristles of the upper row simple, or with a distal process and serrated edge beneath; in the fourth segment simple, serrated; at the twelfth segment with long simple tips above the serrated region; at the thirteenth segment the bristle is bifid, with a few serrations on the curved limb. In the inferior

division compound bristles, the terminal process having a hook distally and a process beneath it (Langerhans).

Langerhans thinks that this form agrees with Delle Chiaje's *rubra* and *vittata* in the upper bristles, but possesses only two eyes.

The foot (Plate LXXXVII, fig. 9 *a*) differs from that of *S. rubrovittatus* in the inconspicuous condition of the two upper processes, but it more nearly approaches that of *S. Kefersteini*.

The dorsal bristles (Plate LXXXVI, fig. 10) are translucent, long, slender and finely tapered, with serrations on the edge below the long smooth tip, whilst the bifid forms (Ibid., fig. 10 *a*) have a longer and a shorter limb, about half a dozen serrations occurring on the edge below the latter. The ventral series of falcate bristles (Ibid., fig. 10 *b* and *b'*) has the terminal piece long and slender as well as bifid.

The exact position of the Plymouth example is uncertain. It may be immature. The figures of Langerhans certainly differ from the structures observed in this form, but they may not be accurate.

Genus LXII.—Ophryotrocha, *Claparède and Mecznikow*, 1869.

Small forms with horse-shoe-shaped head; eyes four; two short dorsal tentacles in front of the eyes, and two similar tentacles ventrally. Body comparatively short, first two segments devoid of feet; two clavate cirri posteriorly. Proboscis armed with a complex upper dental apparatus, and an *f*-shaped mandible. Foot resembling that of *Staurocephalus*, with simple upper bristles and compound lower bristles. Oviparous.

1. Ophryotrocha puerilis, *Claparède and Meczn.*, 1869. Plate LV, fig. 9—head and anterior region; Plate LVI, figs. 4 and 5; Plate LXI, figs. 10 and 10 *a*—young and teeth; Plate LXXIII, fig. 7—foot; Plate LXXXII, figs. 1 and 1 *a*—bristles.

Specific Characters.—Head horse-shoe shaped, with palpocils anteriorly. Eyes variable, generally four, two situated externally in a dimple behind the dorsal tentacle, and two smaller on the summit of the head just in front of the nuchal fold. Occasionally a pigment-spot or two in front of the latter. In front of each anterior eye a small tentacle of two segments, the basal shorter than the distal. A pair of tentacles of similar structure on the ventral surface. Body nearly half an inch long, of more than thirty segments, slightly tapered at each end, pale and translucent. First two segments devoid of feet. Two clavate cirri posteriorly. Proboscis with dark brown or blackish, strongly curved maxillæ, and with an acute posterior process. Six denticles beneath and in front, each hoof-shaped, with the free edge denticulated, and diminishing in size from before backward. Mandible elongated and curved like the letter *f*, cutting edge bifid, each cusp being arcuate. Foot resembles that of *Staurocephalus*, with four conical terminal processes. At the upper end is the conical dorsal lobe. Beneath is a conical process for the spine, one margin of the foot trending obliquely into the setigerous

region, whilst the other leads to the ventral lobe (cirrus) nearer the body. Dorsally are three translucent bristles with slightly flattened tips, which end in a hook. Below the spine are about six compound bristles, the ends of the curved shafts dilated and bevelled for the terminal piece with a simple (?) tip.

Synonyms.

1869. *Ophryotrocha puerilis,* Claparède and Mecznikow. Zeitschr. f. wiss. Zool., Bd. xix, p. 184, Taf. xiii, f. 2.
1878. „ *Claparedii,* Studer. Arch. f. Naturges., xliv, p. 119, pl. v, f. 11.
1884. „ *minimus,* Langerhans. Zeitschr. f. wiss. Zool., Bd. xl, p. 257, Taf. xv, f. 16.
1885. *Staurocephalus Siberti,* McIntosh. Ann. Nat. Hist., ser. 5, vol. xvi, p. 482, pl. xiii, f. 5—8.
„ *Ophryotrocha puerilis,* Carus. Fauna Medit., p. 217.
1886. „ „ Viguier. Arch. Zool. expér., 2e sér., t. iv, p. 417, pl. xxv, f. 11—17.
„ *Paractius littoralis,* Marenzeller. Die Österr. polarstat. Jan Meyen, III, Zool. Würmer, p. 21.
1888. *Ophryotrocha puerilis,* De St. Joseph. Ann. Sc. nat., 7 sér., T. v, p. 239, pl. x, f. 96—98.
„ *Paractius mutabilis,* idem. Ibid., p. 240, pl. x, f. 103—112.
1890. „ „ Malaquin. Rev. Biol. du Nord. (Annél. Boulon), T. iii, p. 381.
„ *Ophryotrocha puerilis,* Giard. Bullet. Sc. Fr. et Belg., T. xxii, p. 77.
„ „ „ idem. Ibid., T. xxii, p. 77.
1892. „ „ Monticelli. Monit. Zool. Italiano, III, p. 250 (fide aut.).
1893. „ „ Bonnier. Bullet. Sc. Fr. et Belg., T. xxv, p. 198, pls. 1—4.
„ „ „ idem. Compt. Rend. Acad. Sc., T. cxvi, p. 524.
1895. „ „ (development), Korschelt. Zeitschr. f. wiss. Zool., Bd. lx, p. 543, pls. 27—34.
„ „ „ idem. Ibid., Bd. lx, pp. 543, 689.
1902. „ „ McIntosh. Ann. Nat. Hist., ser. 7, vol. x, p. 257.
1904. „ „ Allen. Journ. M. B. A., n.s., vol. vii, p. 226.
1905. „ „ Graeffe. Arbeit. Zool. Stat. Triest., xv, p. 322.

Habitat.—When at Whitstable in June, 1884, a small Eunicid was noticed in an aquarium belonging to Mr. Sibert Saunders, who kindly forwarded examples to the St. Andrews Marine Laboratory. The specimens had been procured from the oyster-beds at Whitstable, so that in all probability the species haunts the Algæ and other growths attached to the shells of the oysters. Plymouth (Garstang and Allen).

Shores of France (Giard and Bonnier) amongst Bryozoa and Ascidians, as well as on the tubes of *Sabellaria.* Body-cavity of *Cucumaria plauci* at Naples (Monticelli).

Studer[1] found a very similar species in Kerguelen.

Head (Plate LXI, fig. 10, and Plate LV, fig. 9) horse-shoe shaped, with a series of rather long palpocils on the whole of the anterior edge. These organs have broad bases, taper to a fine point, and apparently are of great tactile sensibility. Their motions on the edge of the snout are so lively that it seems to be ciliated. The number of eyes is variable, two being situated externally in a dimple behind the dorsal tentacle. They are simple pigment-spots, blackish by reflected and pale brownish by transmitted light. The snout often shows a slight furrow nearly opposite each eye, apparently the second ciliated crown of Bonnier. On the summit of the head just in front of the nuchal fold is a small pair of eyes placed near each other, and occasionally a pigment-spot or two in front of these.

[1] 'Archiv f. Naturges.,' 1878, p. 119, Taf. v, fig. 11.

In front of each anterior eye is a small tentacle of two segments, the basal shorter than the distal, which is bluntly rounded and furnished with palpocils similar to those on the anterior arch. A pair of tentacles having the same structure occupy a corresponding position on the ventral surface of the snout, but they are more external in position so that they project distinctly on each side. Claparède and Mecznikow describe a ciliated groove between the head and the following segment.

Body from 8 or 9 mm. to nearly half an inch in length, with more than thirty bristled segments. It is little tapered anteriorly, and only slightly so posteriorly. It is pale and semi-translucent, the internal organs, viz., the blackish dental apparatus and the straw-coloured or greenish alimentary canal, being visible from the exterior. Two segments behind the head are devoid of feet. The feet project outward somewhat stiffly. Posteriorly are two clavate cirri provided with palpocils which proceed from a caudal segment devoid of feet.

The armature of the proboscis (Plate LXI, fig. 10*a*) consists of dark-brown or blackish, strongly curved, and sharp-pointed maxillæ, behind which an acute posterior process projects. Six denticles, which probably represent the dental plates of allied forms, occur beneath and in front of these, each being shaped somewhat like a hoof, the free edge anteriorly being finely denticulated. They diminish in size from before backward, the last having a long slender process which reaches the posterior border of the maxillæ. Young examples have a smaller number of denticles. The mandibles are elongated and curved like the letter *f*, a wing-like border occurring close behind the anterior region. The cutting edge is bifid, and both cusps are minutely crenate.

When fully formed the foot (Plate LXXIII, fig. 7), like that of *Staurocephalus Keferstenii*, has no dorsal cirrus, but projects somewhat stiffly outward with four conical terminal processes. At the upper end is the conical dorsal lobe, which rises from the dorsal margin of the foot by a long stiff slope, whilst the distal border is shorter and more nearly vertical. Beneath is the blunt or expanded conical process for the long translucent spine, one margin of the foot then trending obliquely outwards into the elongated process for the compound bristles of the region, whilst the other leads to the ventral lobe, which is less prominent than the other processes, that is, is nearer the body, as usual in the group, and has a long ventral and a shorter distal slope. The bristles also differ from those of any other species observed. Dorsally above the spine are about three elongated translucent bristles (Plate LXXXII, fig. 1), with slightly flattened tips (in one short) which end in a short point slightly hooked. No serrations are visible on the edge in the preparations. Below the spine and little separated from the upper series are about six compound bristles equally translucent. The shafts are curved toward the end, which is also dilated and bevelled for the terminal piece. The two upper bristles are as long as the dorsal, but the rest diminish in length inferiorly. All, however, are proportionally long. The terminal pieces appear to be simple, but it is sometimes very difficult to observe a minute secondary process if close to the point (Plate LXXXII, fig. 1 *a*).

Reproduction.—All the examples observed, and they were under observation for several months, had large ova internally, their longer diameter being nearly equal to the vertical diameter of the foot. Mr. Garstang thought the breeding season of the species was in August, but Dr. Allen has since found it spawning in the tanks in May.

At Naples Lo Bianco[1] states the ova are deposited from January to May, so that in our country it is somewhat later, but it evidently extends over several months.

Habits.—It is very hardy in confinement and breeds freely. It crawls actively on the seaweeds and zoophytes or along the glass.

The description and figures of Claparède and Mecznikow had been overlooked when the first account of the British examples was drawn up, but comparatively little alteration is necessary in regard to either. The figure of the maxillæ and mandibles given by these authors, indeed, is not characteristic of our forms, and probably considerable variation exists, though the amalgamation of the anterior denticles is different from anything seen in the British forms, which have a row of six separate processes. The lateral view of the foot also (fig. 2 F) has been from an injured or imperfectly preserved example. The older authors' views of the body and head, however, are good, and their account and figures of the young are also accurate. They describe and figure an eyeless larva 0·3 mm. long with five ciliated rings, tactile cilia on the prostomium, and a median caudal cirrus. The dental apparatus shows the mandibles and rudimentary maxillæ (the joint authors' labrum). Then two lateral caudal cirri are developed by-and-by, and finally feet. When 2·5 mm. long two black eyes appear and the ova are ripe. The authors do not allude to the male.

De St. Joseph (1888) described and figured this species under the name of *Paractius mutabilis*, and had found it in considerable numbers at Dinard. He, however, pointed out that it probably fell under the same genus as *Staurocephalus minimus*, Lang., *S. Siberti*, McIntosh, and *Ophryotrocha puerilis*. In the same contribution he figured a young example as *Ophryotrocha puerilis*, the condition of the dental apparatus apparently having misled him.

A careful account of this species was given in 1893 by Bonnier from specimens preserved at Wimereux, where it had formerly been found by the distinguished founder of the Laboratory, Prof. Giard. Bonnier rightly gives a wide margin for variation in this almost cosmopolitan species, and the dental apparatus especially shows divergences. Thus in the British examples the lateral denticles are much less prominently denticulated than in those from Wimereux. Moreover the terminal lobes of the feet differ slightly. Bonnier shows three or four of the posterior denticles as boldly denticulated, whereas in ours only one (the most posterior) presented this structure. Bonnier criticises the groups of Ehlers, viz., the Labidognatha and Prionognatha, averring that in its young condition (four to fifteen segments) *Ophryotrocha* is like one of the Prionognatha, whereas in its adult state it resembles a Labidognath. The classification therefore holds only in the adult condition. This author also considers *Paractius*, Levinsen, from Greenland, as synonymous. It presents the larval character of a band of cilia around each segment.

Häcker (1896) mentions a larval form with "intertrochalen" ciliated rings.

Czwiklitzer[2] lately removed the head-segment in one, with the result that degenerative processes followed for six weeks, viz., loss of cirri, bristles, and most of the feet, but a week later there was complete regeneration of the lost parts. If the first segment is removed, the second may take on the character of the head. When the first and second segments

[1] 'Mitth. Zool. Stat. Neap.,' xiii, p. 489, and ibid., xix, p. 583.

[2] 'Arch. Entwickelung.,' xix, p. 140, and figs., 1905; and 'Journ. R. Micr. Soc.,' Feb., 1906, p. 28.

are removed no regeneration ensues. Minor injuries to the first segment are rapidly repaired.

Another experiment was made by Braem,[1] who halved a female example with ripe eggs. The anterior region with the head and thirteen segments regenerated seven segments in three weeks. Moreover, the female elements had disappeared, and were replaced by male. The author thought that in consequence of the injury the indifferent germ-cells had developed into male cells.

Eunicea labidognatha nuda.

Both halves of the jaws have an equal number of pieces. No true cephalic tentacles. Some with and some without branchiæ.

The body-wall in the Lumbrinereidæ (Fig. 75) is characterized by the toughness and iridescence of the cuticle, the comparative thinness of the hypoderm and the circular layer,

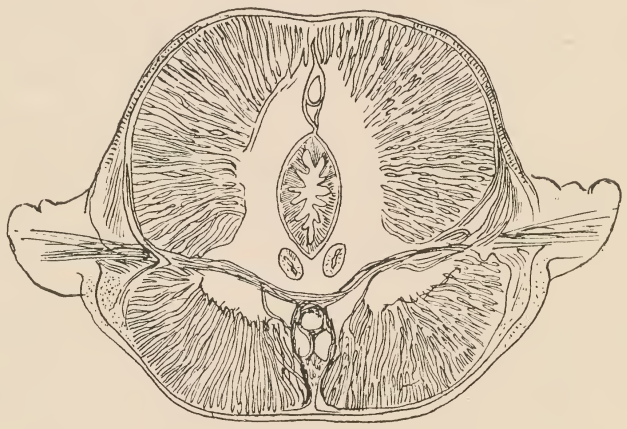


Fig. 77.—Transverse section through the body-wall of *Lumbriconereis fragilis*. The massive condition of the dorsal and ventral longitudinal muscles is apparent. The oblique muscles are attached above the nerve-cords.

and the massiveness of the dorsal and ventral longitudinal muscles, which occupy the greater part of the area in transverse section. Moreover, the marked dissimilarity which usually distinguishes the dorsal from the ventral longitudinal muscles is in this group not apparent. Both form compact masses of fibres, slightly diminished towards the middle line dorsally and ventrally. The ventral muscles form the thickest and shortest masses, though, as mentioned, the usual disproportion is not pronounced. In consequence of the great development of the ventral muscles the nerve-cords are pushed inward, their connection with the superficial parts being by a pedicle. As a rule a conspicuous neural canal occurs superiorly, and it is often as large as the great ventral vessel above it. To the dorsal edge of the investment above the neural canal the oblique muscles are attached. Fibres from the circular muscular layer seem to pass across the gap at the pedicle. In certain forms, as in *Lumbriconereis impatiens*, a smaller neural canal exists in each trunk below the larger, and indications of a second (branch) occasionally appears. In some the

[1] 'Anat. Anzeiger,' xxxiii, pp. 19—27, 2 figs., 1908.

deeply stained nerve-cells not only form an external investment, but go downward almost to the outer end of the pedicle.

In the mid-dorsal line a mobile band passes from the circular layer to the muscular walls of the dorsal blood-vessel, and thereafter is continued to the arch of the alimentary canal, the nuclei of the cells of which are mostly external.

The form mentioned by Donati[1] as living in a cavity or tunnel in a sponge is probably one of this family (Lumbriconereidæ), from its general structure and iridescence. The figures are, however, too indefinite for accurate identification.

Pallas described an example under the title *Nereis ebranchiata*, and De Blainville placed the *Lumbricus fragilis* of O. F. Müller under the genus *Scoletoma*.

Grube,[2] after Savigny, made *Lumbriconereis* one of the genera of the Euniceæ, the others being *Diopatra*, *Onuphis*, *Eunice*, *Lysidice*, *Aglaura*, and *Œnone*.

The Lumbriconereida constitute the fifth family of Kinberg's[3] Eunicea, characterized by eight maxillæ, part Ii edentate, tentacles tubercle-like or none, branchiæ absent. He gives only two families, viz., *Eranno*, in which the tentacles are two and tuberculiform, and *Lumbriconereis*, in which they are either obsolete or absent.

Claparède and Mecznikow (1868)[4] give an account of the development of what they considered a *Lumbriconereis* or an allied form. The youngest stage is spherical, with a long tuft of cilia in front, two reddish eyes with lenses, a general covering of cilia, with a gap posteriorly, and then a broad but short caudal tuft. The alimentary canal and its glandular coat are differentiated. The following day the outline is pear-shaped, and the posterior ring of cilia is better developed. On the fourth day greater elongation ensues, and the proboscis is apparent, whilst the broad anterior coating of cilia and the caudal ring are more conspicuous. Then a few larval bristles appear on each side posteriorly, and this region soon shows two distinct tufts of bristles elevated on rudimentary feet, and a pair of short caudal cirri on cirrophores, whilst the proboscis is armed with what appear to be maxillæ, great dental plates, and mandibles in an early condition.

Carus (1885) makes the Lumbriconereidæ a sub-family of the Eunicidæ.

Häcker (1896) quotes Fewkes as stating that *Lumbriconereis* lays eggs in galleries, and has non-pelagic young. Fewkes says that from each pigment-spot, cephalic or caudal, a number of delicate threads pass toward the centre of the larva, and that they are ultimately lost in the larval body.

In his 'Annelids of the Shores of Dinard,' De St. Joseph,[5] while criticising Grube's classification, which he considers to be a combination of the systems of Kinberg and Ehlers, follows a similar arrangement.

The veteran student of the Annelids, Prof. Grube,[6] published, the last year of his life (1879), a careful general account of the Lumbriconereidea, primarily subdividing them according to the absence or presence of dorsal cirri, the bristles and teeth being of

[1] 'Della Storia Naturale Marina dell'Adriatico,' Venezia, 1750, p. 59, Tav. viii, figs. G, H, J, K.
[2] 'Fam. der Annel.,' p. 293, 1851.
[3] 'Öfvers. af-K. Vet.-Acad.,' 1864, No. 10, p. 567.
[4] 'Zeitschr. f. wiss. Zool.,' xix, p. 182, Taf. xv, figs. 1—1H.
[5] 'Ann. Sc. nat.,' 7e sér., t. v, p. 192, 1888.
[6] 'Jahresber. Schles. Gesellsch.,' 1879, p. 78.

service in the subdivisions. In arranging the representatives of the genus *Lumbriconereis* he made use of the structure of the jaw-plates and the shape of the head, or in sections B and C the condition of the bristles. He gives *Lumbriconereis* four jaw-plates, the next genus *Larymna* having five plates. Under the section B, just mentioned, there are large winged bristles, and the maxillæ have elongated, slender posterior appendages. The mandibles (*lamina ventralis*) are horny, black, bilobed in front, the short limbs united or split. Under this head come *Drilonereis* and *Arabella* with four pairs of jaws, and *Aracoda* and *Maclovia* with five pairs of jaws. Unlike Kinberg, he regarded the biannulate buccal region as a single segment.

The Lumbrinereidæ formed one of the families of Levinsen's Euniciformia vera (1883) following the Onuphidæ, a position in keeping with their structure. Benham includes the group under his Eunicidæ, a family of the Nereidiformia.

One of the most recent classifications of the group is that of Gravier, who has done excellent work, especially amongst the foreign Annelids :

Rudimentary dorsal cirrus	Capillary bristles accompanied by hooks or compound bristles	Digital branchiæ fixed to setigerous lobe		*Ninoe*, Kinberg.
		No branchiæ	Four pairs of jaws	*Lumbriconereis*.
			Five pairs of jaws	*Larymna* (including *Zygolobus*, Grube).
	Only capillary winged bristles	Four pairs of jaws	One pair of jaws (hooked)	*Laranda*, Kinberg.
			One pair of jaws not hooked, two filiform supports	*Notocirrus*, Schmarda.
		Four or five pairs of jaws; two first segments achetous	Jaws of the third and fourth pairs reduced to hooks	*Drilonereis*, Claparède (De St. Joseph, char. emend).
			Jaws of the third and fourth pairs denticulated plates; jaws of second pair unequal	*Arabella*, Grube (De St. Joseph, char. emend., *Maclovia*).
		Five pairs of jaws	First segment achetous	*Aracoda*, Schmarda.
Foliaceous dorsal cirrus	Three antennæ inserted on posterior part of prostomium	Supports of upper jaw long and filiform	Four eyes, six pairs of jaws	*Danymene*, Kinberg.
			Two eyes, five pairs of jaws	*Halla*, A. Costa.
		Support of upper jaw short—in form of a plate		*Lysaretea*, Kinberg.
	Three antennæ covered by the prostomium; nucal organ forming two voluminous organs behind antennæ			*Aglaurides*, Savigny and Ehlers.
	No antennæ, no nuchal organs			*Œnone*, Savigny.
Parasites or commensals	Four eyes	Lower jaw much developed, parasitic or commensal on Syllideans		*Labrorostratus*, De St. Joseph.
		Lower jaw much reduced, a parasite or commensal of *Bonellia*		*Oligognathus*, Spengel.
	No eyes	Parasitic or commensal in *Terebellides Strœmii*		*Hæmatoclyptes*, Wirén.

In this group are instances of the somewhat rare endo-parasitism of Polychæta, indeed, the majority of the examples appear to pertain to it, and, further, they are parasitic on Vermidia of one kind or other, chiefly Polychæta. Thus the Amphinomids *Hipponoë Gaudichandii* and *H. Mülleri* inhabit *Lepas anatifera*; and the Ctenophore *Cydippe densa*, Forsk., is the home of *Alciopina parasitica*; whilst *Ophiuricola cynips* is found in a deep-sea Ophiuroid (*Ophioglypha tumulosa*). The Lumbriconereid forms, again, are *Oligognathus Bonelliæ*, which haunts the Gephyrean *Bonellia*; *Hæmatocleptes terrebellidis* occurs in a blood-sinus of the gut of *Terebellides strœmii*; *Labrorostratus parasiticus* is found in the body-cavity of various Syllids, viz.:—*Odontosyllis ctenostoma*, *Eusyllis monilicornis*, *Syllis prolifera*, *Pionosyllis lamelligera*, and *Grubea clavata*; and another Lumbriconereid in the same cavity in *Marphysa sanguinea*. Lastly, Monticelli met with *Ophryotrocha puerilis* in the body-cavity of *Cucumaria Planci* at Naples.

The Lumbrinereids are common in mud, indeed some, such as the red form mentioned by Mr. Crossland, are the only inhabitants of the mud which forms the bottom between the coral reefs in Red Sea harbours.

Genus LXIII.—Lumbriconereis, *De Blainville*, 1828 (char. emend.).

Head more or less conical, without tentacles or palpi; a neck-fillet with retractile papillæ. Mouth with two lips. Body elongated, distinctly segmented, little tapered anteriorly, but more distinctly so posteriorly, where it terminates in four anal cirri. Two smooth segments behind the head. Maxillæ smooth with basal processes; maxillary plates symmetrical, toothed, and with a broad horny ledge. Mandibles connate in the broad middle region anteriorly, and diminishing posteriorly. Foot with a long terminal flap, simple and compound bristles, in the posterior segments (and in the young in all) simple hooks. Body-wall as in the type (see p. 368). The circulation is highly developed, and the vascularity of the feet is characteristic. The segmental organs, reproduction, and development are all in need of further investigation.

Kinberg[1] made two divisions of the genus *Lumbriconereis*, viz., (1) those having maxilla IIIi unidentate, and (2) those with the same part bidentate.

Ehlers (1868) points out the substitution by Grube of the term *Lumbriconereis* for *Lumbrinereis*, Blainville; and amalgamates *Scoletoma*, Blainville, *Zygolobus*, Grube, and *Eranno*, Kinberg, with the genus, whilst *Aracoda*, Schmarda, and *Notocirrus*, Schmarda, are also partially connected with it.

The species range from tide-marks to very great depths, *e.g.*, in the 'Challenger' to 2225 fathoms.

A form (*Lumbriconereis*) occurs in the fresh waters of Trinité[2] (Trinidad?).

Gravier[3] mentions Miss F. Buchanan's observations on the regeneration of the anterior region in *Lumbriconereis impatiens* and in *Halla*. Regeneration of the tail is more frequent.

[1] 'Öfversigt af-K. vet.-Akad. Förhandl.,' 1864, pp. 568 and 569.

[2] Benham, 'Camb. Nat. Hist.,' ii, 1897.

[3] 'Ann. Sc. nat., Zool.,' 9e sér., t. ix, p. 136, 1909.

Claparède and Mecznikow (1868) gave the early stages of the development of a species of *Lumbriconereis* which they found at Naples in November and December, and though the precise relations of the form are unknown, it may be mentioned that the youngest stage is a rounded trochophore having two reddish eyes with lenses, a central digestive region, a long anterior whip of cilia, and a broad ciliated ring behind the eyes, as well as a posterior tuft. The following day the shape is more elongate (pear-shaped). On the fourth day the long anterior whip has disappeared, but the broad zone behind is in full development, as also is the posterior cincture. The digestive tract shows an anterior (pharyngeal) and a posterior region, whilst a pair of bristle-bundles appears in front of the anal ring. Two bristle-tufts occur on the eleventh day, and the anal ring of cilia has disappeared. The prostomial region is larger. At a later date the young annelid shows two well-marked setigerous segments, a conical prostomium with a lateral eye-speck on each side, the pharynx is sunk in the digestive tract, and two short anal cirri occur posteriorly. The outline is elongate ovoid. The authors were uncertain whether the form belonged to *Eunice*, *Lumbriconereis*, or *Notocirrus*. The figures of the bristles are so small that little help is obtained from them.

1. Lumbriconereis fragilis, *O. F. Müller*, 1788. Plate LXII, figs. 1 and 1 *a*—teeth; Plate LXXIII, figs. 8–8 *c*—feet; Plate LXXXII, figs. 2–2 *b*—bristles.

Specific Characters.—Head conical and smooth, with a dimple posteriorly leading into two nuchal pits with papillæ. Body 5—10 or more inches in length, ending in four caudal cirri. First segment longer than the second. Colour iridescent brownish. Mouth opens behind two massive lips separated by a median fissure, with a curved and crenate hind lip. Maxillæ boldly curved, continued posteriorly into two spear-shaped processes. Great dental plates with four teeth (five to six, Ehlers). Inner lateral plate has a horny tooth internally, and so with the outer. Horny patch behind these fits against the tooth, and externally a horny bar passes towards the maxilla. Mandibles anchylosed, with dense whitish calcareous edges. Body-wall (Fig. 77) massively muscular, the great thickness of the ventral longitudinal muscles being conspicuous. Foot with simple winged bristles as far as the twenty-first, when winged hooks appear. Anterior lobe bluntly rounded, the posterior with a nearly horizontal dorsal edge, a bluntly conical point, and then, after fusing with the lower edge of the anterior lobe, sloping inward and backward to the body. The space between the lobes greater in the anterior foot. Feet increase in length posteriorly, and the hind lobe becomes pointed. Hook with a shaft like that of the bristles, but after the curve and expansion it contracts to a neck. The terminal hook has a serrated crown and is guarded by a wing on each side. Spines four in number, black. The tapering winged bristles disappear before the sixtieth foot, the posterior feet having only the winged hooks and two black spines.

Synonyms.

1776. *Lumbricus fragilis,* O. F. Müller. Zool. Dan. Prodr., p. 216, No. 2611.
1788. „ „ idem. Zool. Danica, i, p. 22, Taf. xxii, f. 1—3.
1791. „ „ Linnæus. Syst. Nat. (Gmelin), ed. 13, i, pt. vi, p. 3086.
1825. *Nereis fragilis,* De Blainville. Dict. Sc. Nat., xxxiv, p. 454.
1827. *Lumbricus fragilis,* Bruguière. Encycl. Méth., Tab. liv, f. 15a.
1828. *Scoletoma fragilis,* De Blainville. Dict. Sc. Nat., lvii, p. 492.
1833. *Lumbrinereis fragilis,* Aud. & Edw. Ann. Sc. nat., t. xxviii, p. 244.
1835. „ „ Sars. Beskriv. og Iagtt., p. 48.
„ „ „ idem. Nyt Mag. f. Naturvid, vi, p. 209.
1843. „ „ Œrsted. Annul. Danic. Consp., i, p. 15, f. 1 and 2.
„ „ „ idem. Reg. Marinis, p. 78.
1844–5. „ „ idem. Kroyer's Nat. Tids. (Drϕbak), p. 408.
1851. *Lumbriconereis* „ Grube. Fam. Annel., pp. 45 and 124.
1857. *Lumbrinereis* „ Danielssen. Reise, p. 50, and 1858, p. 116.
1864. *Lumbriconereis borealis,* Kinberg. Annul. Nova, Öfvers. af-K. vet.-Akad. Förh., No. 10, p. 568.
1865. „ *fragilis,* De Quatrefages. Annel., ii, p. 365.
1867. „ *borealis,* Malmgren. Annul. Polych., p. 63, Taf. xiv, f. 83.
1868. „ *fragilis,* Ehlers. Borstenw., ii, p. 395.
1869. *Lumbrinereis fragilis,* McIntosh. Rep. Brit. Assoc., 1868, p. 337.
1873. „ „ Sars. Bidrag Christ. Fauna, p. 22.
„ „ „ Verrill. Invert. Viny. Sound, U.S. Comm. F. and F., p. 594.
1874. *Lumbriconereis fragilis,* McIntosh. Ann. Nat. Hist., ser. iv, vol. xiv, p. 199.
„ „ „ Smith and Harger. Trans. Conn. Acad., iii, p. 16.
„ *Lumbrineries fragilis,* Malm. Göteb. vet. o. vitt. Handl., xiv, p. 85.
1875. *Lumbriconereis fragilis,* Ehlers. Zeitschr. f. wiss. Zool., xxv, p. 53.
„ „ „ McIntosh. Invert. and Fishes St. Andrews, p. 123.
„ „ „ Möbius. Jahresb. Comm. deutsch. Meere, p. 167.
1878. „ „ McIntosh. Trans. Linn. Soc., Zool. I, p. 503.
1879. *Lumbrinereis fragilis,* Tauber. Annul. Danic., p. 101.
„ „ „ Hansen. Nyt Mag. f. Naturvid., xxiv, pp. 5 and 268.
1881. *Lumbriconereis fragilis,* Horst. Niederl. Arch. Zool., Suppl. Bd. i, p. 12.
1883. *Lumbrinereis fragilis,* Wirén. Chœt. Vega Exped., p. 402.
„ „ „ Levinsen. Vidensk. Meddel. Foren. Kjöbenh., p. 224.
1884. „ „ Webster and Benedict. Rep. U.S. Comm. F. and F., p. 720.
1886. *Lumbriconereis fragilis,* Harvey Gibson. Proc. Lit. and Phil. Soc. Liverp., vol. xi, p. 154.
„ *Lumbrinereis fragilis,* Levinsen. Kara.-Hav. Ledorme, p. 8.
1889. „ „ Marenzeller. Arch. f. Naturges., lv, p. 129.
1891. „ „ Hornel. Trans. Biol. Soc. Liverp., vol. v, p. 241.
1893. „ „ Levinsen. Vidensk. Ud. "Hauchs," p. 331.
1901. „ „ Whiteaves. Geol. Surv. Canada, No. 722, p. 80.
1902. „ „ Marenzeller. Polych. Grund., p. 15.
1903. *Lumbriconereis fragilis,* McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 560.
„ „ „ idem. Ibid., vol. xii, pp. 158 and 164.
1908. „ „ Ehlers. Deutsch. Tiefsee Exped., p. 95.

Habitat.—Found at various stations off the British shores in the 'Porcupine' expedition of 1869, at depths ranging from 15 to 1380 fathoms; 30 to 50 fathoms off

Valentia and in Dingle Bay and other parts on the W. and S.W. coasts of Ireland (J. G. Jeffreys). Procured also in the 'Knight Errant' at Station 3; Connemara (A. G. Moore). Most observers have, from the days of O. F. Müller, found it on muddy ground.

Nova Zembla (Théel); Siberia and Behrings Strait (Wirén); Canada (dredged by Dr. Whiteaves). It seems to be northern, and does not reach the Mediterranean.

Head forms a smooth conical process with a dimple posteriorly, which leads into two pits (nuchal), into which two small papillæ or bosses project from the first segment.

Body elongate, little diminished anteriorly, but more tapered posteriorly, and ending in four caudal cirri. The first two segments are devoid of feet, and the first is broader than the second. The mouth opens inferiorly behind two massive tips (homologues of palpi?) separated by a median fissure. The hind lip is curved and crenate.

The dental apparatus (Plate LXII, fig. 1) presents a pair of boldly curved maxillæ, the base being continued posteriorly into a spear-shaped process, and each of the great dental plates has four teeth. The inner antero-lateral plate has a prominent tooth internally and so has the outer in most cases. A horny patch occurs behind these and fits against the teeth, and internally a horny bar passes toward the great dental plate. From the ventral surface the broad lamina of the great dental plate has a similar pale area in front, so that the surface is boldly chequered. The mandibles (Plate LXII, fig. 1 *a*) are anchylosed, and have dense, whitish calcareous edges. The fine brown lines run from side to side continuously. The appearances are somewhat the same as in *L. Pettigrewi* of the 'Challenger.'

In this form the nerve-cords in section (Fig. 77) often show a symmetrical arrangement of the neuroglia, the median band passing upward, splitting and surrounding the great dorsal neural canal, which has coagulable contents. The pedicle is shorter than in some species. Additional smaller neural canals occur below the larger, but whether this is due to branches or to the methods of preparation is uncertain.

The first foot has a considerable tongue-shaped lobe (Plate LXXIII, fig. 8) projecting posteriorly, five black spines, and only simple somewhat short winged bristles of the same type, such as exist on the feet behind it. These bristles form two groups, an upper series of longer, and a ventral series of shorter forms with slightly broader wings. The following feet to the twentieth retain this structure except that the posterior lobe becomes a little longer. The anterior lobe is bluntly rounded in lateral view, whilst the posterior has a nearly horizontal dorsal border, a bluntly conical point, and then, after fusing with the inferior edge of the anterior lobe, the outline trends inward and backward with a long curve to the body. The space between the two lobes is greater in the anterior than in the posterior feet, thus affording room for the larger setigerous process anteriorly. Posteriorly, and especially toward the tail, the feet considerably increase in length, and the posterior lobe becomes pointed.

At the tenth foot two groups occur, a dorsal of strong curved bristles with the wings on the convex or inferior edge and a comparatively short tapering tip, and a more numerous lower group with less elongated tips, the edge of the wings often uppermost. The foot is supported by five spines, pale at the base, black throughout the rest of their extent. This structure occurs in the succeeding feet as far as the twentieth, the only

change being the somewhat different arrangement of the bristles, which often form groups of two and three.

The twenty-first foot usually shows the first long winged hook. This has a shaft similar to that of the bristles, but after the bend and expansion, it narrows to a neck, with a terminal hook having a serrated crown. A narrow wing on each side guards the hook and stretches from the dilatation to the tip. This hook appears below the spines, which are four in number. The spines at the thirtieth foot are three in number, but the structure of the foot is little altered except by the presence of the long winged hooks.

At the fiftieth foot or thereabouts (Plate LXXIII, fig. 8 *b*), only a single bristle is present, or occasionally two of the tapering winged type (Plate LXXXII, fig. 2) remain, whilst the strong winged hooks are prominent. These (Plate LXXXII, fig. 2 *a*) have a considerably stouter shaft than the bristle of the same foot, and the shaft is curved distally, the winged region being comparatively short and obliquely striated with fine lines. A constriction forming a neck occurs below the terminal hook which has a crown of minute serrations, directed obliquely forward to the hook. The developing hook has a long filiform cap or process distally (Plate LXXXII, fig. 2 *b*)—apparently a translucent extension of the wing. When seen antero-posteriorly, the double wing is observed to curve inward at the tip on each side and to be attached to the central stem of the hook. Two black spines occur in these and the succeeding feet.

The tapering winged bristles disappear before the sixtieth foot, so that the posterior feet only have the long winged hooks with the comparatively short wing and the two black spines supporting the foot (Plate LXXIII, fig. 8 *c*).

In looking at the feet from above in spirit-preparations a tendency to a "probe-point" at the tip of the posterior lobe is apparent, especially anteriorly. A blood-vessel passes round the posterior lobe of the foot, a little within the margin.

Habits.—An active form. It frequently twists itself into a knot, and occasionally is preserved in this condition.

In a variety from Godhavn Harbour, Greenland, dredged by the 'Valorous,' the tips of the long bristles are remarkably attenuated and have a double curve. Moreover, the posterior lobe of the foot anteriorly is less attenuate, that is, has a broader cone in lateral view. By-and-by, as at the fifty-seventh foot, the attenuation of the long bristles becomes extreme, the tip forming a long, delicate, hair-like process, and the wings are very narrow. The shafts are brownish. The winged hooks have blackish-brown and very long shafts, with a short dilated terminal region and a narrow wing. Both lobes of the feet posteriorly form narrow cones. Whether this is a marked variety remains to be seen. The spines are similar to those of *L. fragilis*.

Langerhans[1] describes *L. fragilis* from Madeira, but his figures of the hooks give rise to some doubt as to the species referred to by him.

Two species described in the 'Challenger' volume[2] from the American coast, viz., *Lumbriconereis punctata* and *L. Ehlersii* var. *tenuisetis*, approach this form in many respects.

A form (B) procured in Herm in 1868 is distinguished from the ordinary *Lumbrico-*

[1] 'Zeitschr. f. wiss. Zool.,' Bd. xxxiii, 1879, p. 297, fig. 30.

[2] Pp. 252 and 253, etc.

nereis fragilis by the much more distinctly segmented body, each segment having a greater antero-posterior diameter, and the feet are thus wider apart. The contour of the foot also diverges, yet it is difficult to express the change in words, though the posterior flap is larger in *L. fragilis*. In addition to the long winged bristles others are peculiarly jointed, for instance, from the first in the tenth foot, and the structure of the posterior hooks also differs, as likewise do the spines which are not black.

A variety of *L. fragilis*, from the south west of Ireland, off the Blasquet, has in the tenth foot the middle group of bristles slightly blunted, so as to form a stage in its approach to the foregoing.

2. Lumbriconereis Latreillii, *Audouin and Edwards*, 1834. Plate LIV, fig. 6; Plate LXXIII, figs. 9 and 9 *a*—feet; Plate LXXIV, fig. 12—head; Plate LXXXII, figs. 3–3 *c*—bristles.

Specific Characters.—Head a short blunt cone, with a median band attached to the succeeding segment in the centre posteriorly, and at each side of the latter a dimple receiving a process from the first segment. Two papillæ in front of the mouth are transversely elongated. Body similar to that of *L. fragilis*, with four anal cirri. Maxillæ strongly curved and rather short, the basal plates trending to a short posterior lozenge. Great dental plates with four teeth; each antero-lateral with one tooth; a horny patch in front, and a horny bar outside the anterior half of the maxillæ. Mandibles have spathulate anterior ends anchylosed in a wide angle, and two short roots. First foot has three pale spines, a short, bluntly conical posterior flap, winged tapering bristles superiorly and inferiorly, and among the latter one or more winged jointed hooks, the ends of which have four or five spines. Typical foot (as far as seventeenth) has a nearly horizontal edge to the posterior lamella, whilst the ventral edge is long and sinuous. Spines (four) pale. Tapering winged bristles superiorly; articulated hooks, with the distal end of the shaft slightly curved backward and dilated, and with a narrow wing on each side. End of shaft bevelled to a sharp point, and with a posterior fillet. Terminal piece of considerable length, diminishing distally, constricted at the neck of the hook, which is small, with several sharp spikes above it. One or two winged bristles occur below the spines at the ventral border of the foot. Behind the foregoing simple winged hooks take the place of the jointed. The foot also has a more abrupt inferior curve, so that its depth is increased. Posterior feet have the posterior lobe prominent, and the hooks have the primary fang large.

Synonyms.

1834. *Lumbrinereis Latreillii,* Aud. and Edw. Annel., p. 168, pl. iii B, f. 13—15.
1840. *Lumbriconereis Nardonis,* Grube. Actin. Echin. und Würmer, p. 79.
1851. ,, ,, idem. Fam. Annel., pp. 45 and 124.
1862. ,, *tingens,* Keferstein. Zeitschr. f. wiss. Zool., Bd. xii, p. 102, Taf. ix, f. 1—9.
1863. ,, *Edwardsii,* Claparède. Beobacht., p. 58, Taf. xiv, f. 14—22.
1864. ,, ,, Grube. Insel Lussin, p. 79.
,, *Zyglobus Edwardsii,* Claparède. Glanures Zoot., p. 114.
1865. ,, ,, De Quatrefages. Annel., i, p. 366.

1868. *Zygolobus tingens,* Ehlers. Borstenw., ii, p. 391, Taf. xvii, f. 11—14.
„ *Lumbriconereis Nardonis,* idem. Ibid., ii, p. 381, pl. xvi, f. 23—30.
„ „ „ Claparède. Annél. Nap., p. 147, pl. ix, f. 3.
1870. *Zygolobus Latreillii,* Grube. Arch. f. Naturges., xxxvi, p. 302.
1875. *Lumbriconereis Latreillii,* Marion and Bobretsky. Ann. Sc. nat., 6e sér., t. ii, p. 15.
„ (Under *L. fragilis*) Ehlers. Zeitschr. f. wiss. Zool., xxv, p. 54, Taf. iii, f. 22, 23.
„ *Lumbriconereis Latreillii,* De St. Joseph. Ann. Sc. nat., 6e sér., t. ii, p. 15.
1879. „ *Nardonis,* Grube. Jahresb. Schles. Gesells. (for 1878), p. 90.
„ „ *tingens,* idem. Ibid., p. 91.
1885. „ *Nardonis,* Carus. Fauna Medit., p. 215.
1888. „ *tingens,* De St. Joseph. Ann. Sc. nat , 7e sér., t. v, p. 212, pl. viii, f. 62—64.
1890. „ „ Malaquin. Annél. Boulon. in Rev. Biol. Nord. Fr., ii, p. 180.
1896. „ *Latreillii,* Roule. Camp. 'Caudan,' p. 449.
„ „ *Nardonis.* Polych. deutsch. Meere, p. 14.
1898. „ *Latreillii,* De St. Joseph. Ann. Sc. nat., 8e sér., t. v, p. 276.
1903. „ *Nardonis,* McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 561.
1904. „ *Latreillii,* Allen. Journ. M. B. A., N.S., vol. vii, p. 226.
1905. „ *Nardonis,* Graeffe. Arbeit. Zool. Stat. Triest, xv, p. 321.

Habitat.—Not uncommon under stones between tide-marks, St. Peter Port, Guernsey, and in Herm. Deep sea fishing off St. Andrews Bay, and in the stomach of the flounder (E. M.). Plymouth (Allen). Loch Slyne, Co. Cork, R.I.A. Exped., 1886.

Naples (Claparède). Kaila Bay, Japan Sea, by Capt. St.John, 1874 (W. C. M.); 400 mètres off France (Roule). Eighty-one fathoms off Cape Finisterre, 'Porcupine,' 1870.

The *head* forms a short, blunt cone with a median band in the centre posteriorly attached to the succeeding somite, and at each side of the latter a dimple into which a projecting process of the first segment fits. The under surface in the preparations generally has a median furrow.

Body similar in appearance to that of *L. fragilis*, being slightly diminished anteriorly, and tapered posteriorly, ending in four cirri, which appear (in reproduced tails at any rate) to arise by the bifurcation of two—one at each side of the vent—and there is nothing to contra-indicate this in the fully developed tail.

The first segment is slightly wider than the second. The two papillæ in front of the mouth are transversely elongated. The general aspect of the segments and feet resembles that in *L. fragilis*, the posterior flap of the foot projecting outward, and being slightly probe-pointed when seen from above.

The dental apparatus[1] has superiorly a pair of strongly curved and rather short maxillæ, the basal plates of which trend to a short posterior lozenge (Plate LXV, fig. 12).[2] The great dental plates have each four teeth, and the antero-lateral a tooth each. A horny patch lies to the outer side of the antero-lateral, and a horny bar outside the anterior half of the maxillæ. The mandibles (Plate LXV, fig. 12 *a*) have spatulate anterior ends, anchylosed in a wide V, and two short roots.

The pedicle of the nerve-cords is somewhat long.

The first foot has a short, bluntly conical posterior flap and three pale spines. It

[1] In a female of moderate size.

[2] In the description of Plate LXV, fig. 12, *Nardonis* has been entered for *Latreillii.*

bears superiorly a series of winged tapering bristles with moderately elongated tips. Similar bristles occur below the spines, and amongst them one or more winged, jointed hooks, the ends of which have four or five spines behind the small hook. The wing is narrow. The occurrence of these in the first foot, together with the pale spines, aids in the discrimination of the species.

At the tenth foot (Plate LXXIII, fig. 9) the outline shows a nearly horizontal dorsal edge to the posterior lamella, whilst the ventral edge is long and sinuous. Above the four pale spines the larger tapering winged bristles (three or four in number) occur (Plate LXXXII, fig. 3). Beneath the spines are about four articulated hooks (Plate LXXXII, fig. 3 *b*). The distal end of the shaft of these is slightly curved backward (*i.e.*, from the point of the hook), dilated, and, moreover, has a narrow wing on each side. The end of the shaft is bevelled to a sharp point and has a posterior fillet, thus keeping to the plan of structure seen in the Syllidæ, Nereidæ, and other forms. To this edge is attached the terminal piece, which is of considerable length, flattened, and diminished distally, then constricted at the base of the neck of the hook. The latter is small, with a crown of several sharp spikes above it. The wings are somewhat narrow, so that the lines of the distal region are nearly parallel. Minute striæ slant from above downward and backward over the wings, and a fillet occurs at the neck of the hook. Besides the articulated hooks one or two tapering winged bristles appear below the spines at the ventral border.

This form of foot (Plate LXXIII, fig. 9*a*) with the compound hooks occurs as far as the seventeenth foot or thereabout, but variations exist. Then simple winged hooks take the place of the jointed. The foot also has a more abrupt inferior curve, so that greater depth is given in lateral view.

The thirtieth foot has three or four pale spines, a few rather slender simple tapering bristles superiorly, and the stout winged hooks. At the thirty-fifth foot only a single slender bristle is present, and the same at the fortieth, but this type disappears before the fiftieth foot.

In the posterior feet the hind lobe remains prominent, and the hooks (Plate LXXXII, fig. 3 *c*) are distinguished by the large size of the primary fang.

Reproduction.—An example from St. Peter Port, Guernsey, was distended with large ova in July, and the appearances denoted that the functions of the alimentary canal must have been considerably interfered with.

Claparède thought that this species was closely related to *L. Grubiana* of Port-Vendres, yet the hooks are different.

The *Lumbriconereis oxychæta* of Gravier,[1] from Djibouti, on the Red Sea, appears to be allied in a very close manner with this common form. That so few representatives of Southern Europe should be found in the Red Sea is a noteworthy feature.

Mr. Crossland (*in lit.*) thought that the *Lumbriconereis japonica*, Marenzeller, of the 'Challenger,'[2] might be this species (*L. Johnstoni* in that work), to which it is closely allied; but the posterior appendages of the maxillary apparatus are shorter in the example procured by the 'Challenger,' and, as mentioned in the British form,[3] "the

[1] 'Nouv. Arch. Mus. d'Hist. Nat.,' 4e sér., t. ii, p. 275, pl. xiv, figs. 96—98.

[2] P. 243, pl. xxxvi, figs. 13—15; xviiA, fig. 17; and xviiiA, fig. 1.

[3] *Op. cit.*, p. 245.

dorsal winged bristles are longer and more attenuate, as are also the jointed hooks, the crowns of the latter, moreover, being less distinctly serrated. The bristles are more numerous in the Japanese species, and the posterior lamellæ more acute superiorly. The spines in the foreign forms are black, whereas in the British they are pale." It is possible, however, that intermediate forms may yet occur which will render it necessary to modify the views here expressed.

3. Lumbriconereis impatiens, *Claparède,* 1868. Plate LXII, fig. 2—mandibles; Plate LXV, figs. 8 and 8 *a*—teeth; Plate LXXIII, figs. 10–10 *b*—feet; Plate LXXXII, figs. 4–4 *d*—bristles.

Specific Characters.—Head forming a blunt cone, with conspicuous ciliated organs posteriorly; body typical, but the bristles are somewhat longer than in *L. fragilis*. Tail terminating in four short cirri. Maxillæ strong, with curves which keep to the horizontal. Great dental plates each with four teeth; right anterior plate has three small teeth, whereas the corresponding plate on the left has only an unbroken edge. The other plate has a single tooth. An accessory horny plate and a curved band passing toward the great dental plate complete the upper system. The conformation ventrally resembles that of *L. fragilis*. The mandibles form a long, narrow wedge on each side, and are fused along one-third of the inner border; marked by five curved brown lines anteriorly and by madder-brown longitudinal lines on the reverse side.

First foot is distinguished by the occurrence of long, narrow, unjointed winged hooks and of black spines. Feet in front of seventh show an irregularly conical posterior lobe, somewhat like that of *L. gracilis*, and a narrow anterior lobe. The long winged hooks occur below the spines, and their flattened terminal pieces have nearly parallel sides. These hooks become modified in progress backward, so that at the twentieth foot they are considerably shorter. The dorsal winged tapering bristles form two groups at the thirtieth foot, and they by-and-by diminish, disappearing in the posterior feet. At the fiftieth foot the winged hook has a short tip, and the chief fang is larger; three black spines.

The upper neural canal is often very large, with the usual coagulable contents, and a smaller median canal occurs below it, besides a lateral, which, however, varies in appearance as if from branching (Fig. 78).

Synonyms.

1825. *Lumbricus fragilis,* Delle Chiaje. Mem. Anim. s. Vert., ii, pp. 409 and 428, Tav. xxviii, f. 8—20.
1841. *Lumbrinereis fragilis,* idem. Descriz. e. not., iii, p. 83, Tav. ci, f. 8—11 and 14—20.
1868. *Lumbriconereis impatiens,* Claparède. Annél. Nap., p. 145, pl. ix, f. 2.
1868. „ *breviceps,* Ehlers. Borstenw., ii, p. 388.
1885. „ „ Carus. Fauna Medit., p. 215.
„ „ *impatiens,* Pruvot. Arch. Zool. expér., 2e sér., t. iii, p. 279, pl. xi, f. 5, and pl. xiv, f. 1—3.
1893. „ „ F. Buchanan. Quart. Journ. Micr. Sci., n.s., vol. 34, p. 537.
1898. „ „ De St. Joseph. Ann. Sc. nat., 8e sér., t. v, p. 279.

1903. *Lumbriconereis assimilis*, McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 561.
„ „ „ (near), idem. Ibid., vol. xii, p. 158.
1904. „ *impatiens*, Allen. Journ. M. B. A., N.S., vol. vii, p. 226.
1906. „ „ De St. Joseph. Ann. Sc. nat., 9e sér., t. iii, p. 161.

Habitat.—Stomach of flounder, St. Andrews, and from the deeper water of the Bay (E. M.). Dredged twenty-five miles off North Unst, Shetland, in ninety fathoms, by Dr. Gwyn Jeffreys in July, 1868; Nymph Bank, South-west Ireland, in two and a half fathoms, Royal Irish Academy's Expedition, 1886. In the centre of tubes of *Panthalis Œrstedi*, in fifty to seventy fathoms, west of Peel, Isle of Man (Herdman). Plymouth (Allen).

Shores of France, at Banyuls, in crevices of corallines (Pruvot). Naples and the Mediterranean.

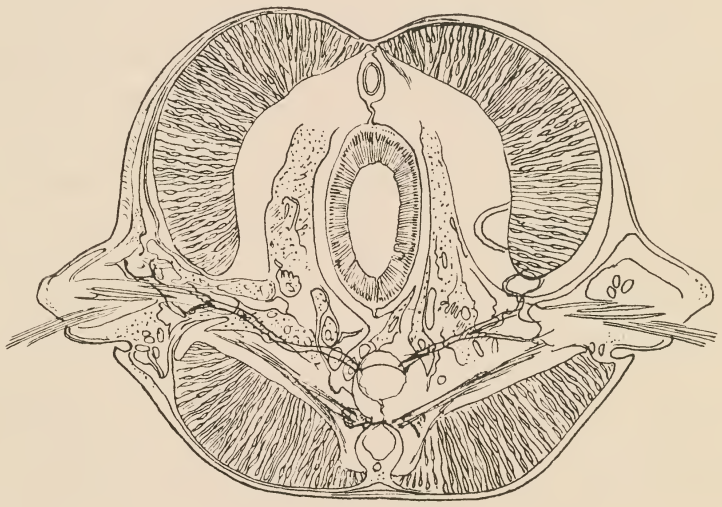


Fig. 78.—Transverse section through a ripe female of *Lumbriconereis impatiens*, the cœlom being occupied by masses of ova.

Head forming a blunt cone as usual in the group, two nuchal organs with vibratile cilia occurring posteriorly.

Body up to 50 cm. (De St. Joseph) and 3 mm. in diameter, the first segment broader than the second, and with numerous rings of nearly equal breadth. The feet generally do not offer diagnostic features in a superficial view, though the bristles are somewhat longer. Delle Chiaje describes it as reddish-brown with fine iridescence, and very fragile, while De St. Joseph gives it a pale rose colour. The segments number between three and four hundred in a large example. Posteriorly it ends in four anal cirri—two dorsal and two ventral. The great development of the dorsal and ventral longitudinal muscles and the position of the nerve-cords are well seen in this species (Fig. 78).

The dental apparatus (Plate LXV, figs. 8 and 8 *a*) presents a pair of strong maxillæ, the curves of which keep to the horizontal, and end posteriorly in a pointed lozenge-shaped process. The great dental plates have each four teeth. The adjoining right anterior plate has three small teeth, whereas the corresponding plate on the left has only an unbroken edge. The other plate has a single tooth. An accessory horny patch and a curved band toward the great dental plates complete the upper system. The conformation

ventrally resembles that of *L. fragilis*. The mandibles (Plate LXV, fig. 8 *a*) form a long narrow wedge on each side, and they are fused along a third of their inner border. A wedge-shaped gap occurs in the centre anteriorly. They are prettily marked on one side by five curved lines of brown anteriorly, and by similar brown lines arranged longitudinally on the reverse side. Considerable variation, however, occurs in the aspect of these organs —probably in connection with regeneration, as may be observed by comparing the foregoing figure with another example (Plate LXII, fig. 2).

De St. Joseph found a *Monocystis* in the intestine of one at Dinard.

The first foot is readily distinguished from allied forms by the occurrence of long hooks with rather narrow wings, and of black spines. The feet in front of the seventh, indeed, show an irregularly conical posterior lobe somewhat like that of *L. fragilis*, and a narrow anterior lobe. There are three black spines. Dorsally are two groups of winged bristles, which have moderately tapered tips. Below the spines is a series of long winged unjointed hooks, the flattened tip of which has parallel sides (Plate LXXXII, fig. 4 *a*), the drawing in this case being from the first foot and showing a differentiation at the end of the shaft, indicating the morphology of the tip, viz., as a modification of a jointed bristle. The distal end has a series (four) of small hooks, the first and last of which are somewhat larger, but not much. On the front (the convex border) of the distal end of the shaft are indications of minute serrations.

The winged hooks (Plate LXXXII, fig. 4) with the elongated tips continue to the tenth foot, though even in this there are signs of modification (Plate LXXIII, fig. 10).[1] The dorsal bristles are split into two fascicles and the tips are similar to those in front. Moreover, the wings are traceable almost to the tip. The upper group has longer, the under shorter tips. The ventral series of winged bristles (below the hooks) resemble those with shorter tips in the dorsal. In lateral view the posterior lobe of the foot is perhaps more massive than in *L. fragilis*. Four black spines are present.

At the twentieth foot the structure of the winged bristles is the same, and especially as regards the continuation of the wings on the filiform tip. The flattened distal region of the winged hooks is now considerably shorter, though in antero-posterior view they retain the slight bend seen in front.

The thirtieth foot has the dorsal bristles in two groups, an upper of stouter winged bristles (Plate LXXXII, fig. 4 *b*) with a marked curve toward the tip, and beneath these a larger group of more slender bristles (Plate LXXXII, fig. 4 *c*), the tips being very attenuate. The median series of hooks has now much shorter tips, but the wings remain narrow, and their slightly bevelled condition opposite the point of the hook is still evident. The fang is comparatively small, and above it is a crown of four or five minute teeth (in lateral view). Inferiorly is a group of stout tapering winged bristles like the upper series of the dorsal. The foot has three strong black spines.

At the fifty-seventh foot only a single bristle of each kind remains above the hooks, which are stouter and now show considerable abbreviation of the tip (Plate LXXXII, fig. 4 *d*). The chief fang is larger. The strongest winged hook is above the three black spines. The tapering winged bristles generally disappear about the sixtieth foot, though a single bristle below the two powerful dorsal hooks is found occasionally considerably beyond

[1] The artist has omitted the winged hooks in the figure.

this foot, whilst the hooks at the eightieth have a larger first fang, a shorter winged region, and increased strength. This bristle would appear to belong to the lower dorsal group, though the tip is now short. From the 70th to the 180th foot (Plate LXXIII, fig. 10 *a*)[1] only two black spines occur in each foot.

The bristles on the whole approach those of *Zygolobus*, though differing in arrangement, and especially anteriorly.

Fage[2] notes that the segmental organ of this form is green, and that the genital funnel is of large dimensions.

A small form dredged in considerable numbers off S.W. Ireland at log 55 in twenty-three to thirty-eight fathoms in 1886 shows certain features resembling the foregoing. At the fifteenth foot some of the winged hooks have very slender tips, the points (hooks) being very minute, but the spines are pale.

Reproduction.—An example procured in Shetland by Dr. Gwyn Jeffreys in July had well-developed ova.

This species attains a comparatively large size in the south. Thus De St. Joseph records one of 34 cm. from St. Vaast (P. Fauvel), and those from Plymouth cannot be much short of two feet.

In Delle Chiaje's 'Memorie' (1825) the maxillæ are represented with only four teeth, as observed in the British examples. Two of the figures are omitted in the 'Descrizione.' He calls the species "Tremolino," and besides the dental apparatus, he describes and figures the alimentary canal, circulation, and nervous system.

This form differs from *Lumbriconereis tingens*, Keferstein, in having the long narrow hooks anteriorly unjointed. It appears to correspond with *Lumbriconereis impatiens* of Claparède from the Mediterranean, a form long previously mentioned by Delle Chiaje as *Lumbricus fragilis* (*non* O. F. Müller), as above noted.

Claparède (1868) cleared up certain ambiguities in Grube's description, especially in the structure of the hooks anteriorly and posteriorly.

Ehlers (1868) observes that his *L. breviceps* has bristles similar to those of *L. impatiens*.

Carus, again (1885), thought this form synonymous with Grube's *Zygolobus laurentianus*, which it can scarcely be.

Pruvot (1885) represents two somewhat clavate lobes of the inferior region of the cerebral mass which pass to the ciliated sacs at the posterior part of the head. He regards the lateral elevations at the mouth as the homologues of the palpi.

Miss Florence Buchanan[3] (1893) describes spirals of different lengths occurring in this species from Naples. She likewise mentions that in this annelid and in *Halla* regeneration of head and tail occurs.

Lo Bianco[4] found this species mature at Naples from May to September.

[1] The artist has omitted the long hooks in this figure.
[2] 'Ann. Sc. Nat.,' 9e sér., III, p. 380, fig. 36, 1906.
[3] 'Quart. Journ. Micr. Sci.,' N.S., vol. 34, p. 537.
[4] 'Mitth. Zool. Stat. Neap.,' xiii, p. 487, 1899.

4. Lumbriconereis hibernica, *n.s.* Plate LXII, figs. 3 and 3 *a*—head; Plate LXXIV, figs. 1 and 1 *a*—feet; Plate LXXXII, figs. 5–5 *d*—bristles.

Specific Characters.—Head forms a somewhat narrow cone with a pointed apex. Body typical; the bristles, however, approach those of *L. impatiens* in length. Posterior lobes of feet not elongated. Maxillæ normal; great dental plates with four teeth. Two lateral plates simple. Mandibles with somewhat elongated anterior plates, the edges of which are crenate. First foot with three or four pale spines, and two groups of tapering winged bristles. The tenth foot has four pale spines and a short conical posterior lobe. Dorsally are winged tapering bristles, whilst below the spines are characteristically tapered simple hooks—indicating how easily such could merge into a tapering bristle. The tips of these gradually shorten, so that at the twentieth they are, proportionally, only half the length. At the thirtieth foot they have short tips and broad wings, and this condition continues to the sixtieth, in which, as in the thirtieth, the lobes of the feet are nearly equal.

Synonym.

1903. *Lumbriconereis hibernica,* McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 561.

Habitat.—Dredged in ninety fathoms, twenty-five miles west of the Blasquet, S. W. Ireland, May, 1869 (Dr. Gwyn Jeffreys); in the same region (log 55) in twenty-three to thirty-eight fathoms, R. I. A. Exped., 1886.

Head (Plate LXII, fig. 3) forms a somewhat narrow cone with a pointed apex, and a slight median groove on the ventral surface.

Body of the normal outline, tapered for a short distance anteriorly, and more distinctly so posteriorly. The first segment is rather broader than the second, and the glistening bristles are more conspicuous than usual, in this respect approaching *Lumbriconereis impatiens.* So far as can be observed in the examples the feet do not present the elongated posterior lobe so characteristic of several forms, but none are complete posteriorly. The segments after the twentieth have a tendency to increase in breadth, and the posterior are about twice the breadth of the anterior. Reproduction of the posterior end takes place readily, a miniature tail sprouting from the last segment, and showing the four cirri at the tip.

The great size of the dorsal longitudinal muscles and the arrangement of the oblique muscles, which pass below the nerve-cord, are noteworthy (Fig. 79).

Proboscis.—In an extruded organ (Plate LXII, fig. 3 *a*) the maxillæ occupy the anterior and central region of the bilobed organ, their action being lateral, that is, each working in and out from its own side. The great dental plates are behind them, their four prominent teeth projecting on each side of the central space in front and slanting inward to the posterior part of the plates. The two lateral plates extend outward on each side, so that an elongated transverse dental series is formed in this position. The mandibles with their double curves and median fissure project a short distance behind, the cutting edge being bare.

So far as can be observed the food would be seized by the maxillæ and lacerated by

the scissor-like action of the great dental plates, aided by the chisel-like effect of the mandibles, which would not only sever pieces held by the maxillæ, but would also press them against the great dental plates. The muscles attached to all these parts are powerful. The action of the parts when inverted would not be very different. When the proboscis is thus thrust out, the head is bent up at an angle, and in semi-extrusion the same tendency is noticed.

The neural canal is small and indistinct, and situated in an upper median segment of the ovoid area in transverse section. The area is surrounded by a dense series of nuclei. The oblique muscles are attached to the upper and outer edges of the area. The hypoderm is comparatively thick and the pedicle long.

The first foot has a small triangular posterior lobe and two groups of tapering winged bristles. One in the centre has a somewhat short tip, and thus may indicate the condition in the following feet. The spines are pale and three or four in number, and

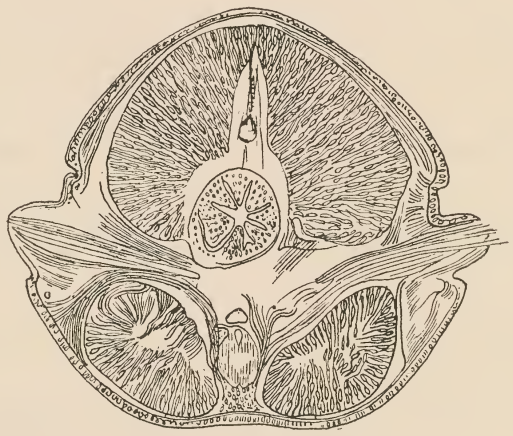


Fig. 79.—Transverse section of the body-wall of *Lumbriconereis hibernica*.

thus the form is readily discriminated from the allied species *L. impatiens*. The second foot has five pale spines.

The tenth foot has four pale spines and a short conical posterior lobe, and a shorter curved anterior lip. Dorsally is a group of tapering winged bristles (Plate LXXXII, fig. 5), with curved and finely attenuate tips. Below the spines is a group of characteristically tapered simple hooks (Plate LXXXII, fig. 5 *a*), which indicate how easily such forms could merge into a tapering bristle. The terminal hook is minute, with a series of coronal serrations. When viewed antero-posteriorly, the double frill of the wings is observed at the tip (Plate LXXXII, fig. 5 *b*). Below are one or two tapering winged bristles.

The tips of the simple winged hooks gradually shorten, so that at the twentieth foot they are proportionally about half the length. The tapering bristles above and below them are similar to those in front. There are four pale spines.

At the thirtieth foot the lobes (anterior and posterior) are more nearly equal, and there are four pale spines. The second or inferior group of dorsal bristles has finely tapered and very long tips, as in certain allied species, and the hooks (below the spines) have now short tips with broader wings (Plate LXXXII, fig. 5 *c*) and long shafts. The

main fang is well marked, and there are three or four spikes above it. A single winged and finely tapered ventral bristle is usually present.

The condition remains much the same (Plate LXXXII, fig. 5 *d*) as the foregoing to the sixtieth foot, beyond which none of the specimens were of service. The differentiation into an upper stouter and a lower more slender set of dorsal bristles continues as far as this foot. The lobes of the feet are nearly equal in this region. Only in the anterior third does the posterior lobe stand backward and outward, and even there the foot has a slightly truncate appearance.

This form seems to be different from any of the preceding.

5. Lumbriconereis gracilis, *Ehlers*, 1868. Plate LXII, figs. 4 and 4 *a*—head; Plate LXXXII, figs. 6 and 6 *a*—bristles.

Specific Characters.—Head forms a blunt cone. Body small, elongated, and finely iridescent, tapering posteriorly to a slender tail. The colour is reddish or brownish-orange (Pruvot and Racovitza). Proboscis with a pair of curved maxillæ which articulate posteriorly with a process having a short anterior and a long tapered posterior region. Each great dental plate has four teeth. The antero-lateral plates are two in number on each side, each with a tooth. Mandibles anchylosed in front, the edge presenting a double crescent, an inner and an outer. The external edge has a pigmented shelf or process. First foot has a small triangular posterior lobe and about four pale spines and tapering simple winged bristles, the adjacent end of the shaft likewise having two wings. The jointed hooks have a short terminal piece with a crown of small hooks and two wings, and broad wings occur on the distal end of the shaft. This hook continues to the fifteenth foot and then disappears, its place being taken by simple winged hooks which by-and-by become stout, the chief fang being strong, whilst above it are three or four erect spines on the crown. As a rule two pale spines are present in each foot, and the latter is bi-papillose from the tenth backward.

Synonyms.

1868. *Lumbriconereis gracilis*, Ehlers. Borstenw., p. 393, Taf. xvii, f. 6—10.
1879. „ „ Langerhans. Zeitschr. f. wiss. Zool., xxxiii, p. 298, f. 31.
1885. „ „ Carus. Fauna Medit., p. 215.
1903. „ „ McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 561.

Habitat.—First procured on muddy ground mixed with clay (eight to nine fathoms) in Lochmaddy, August, 1865. Coast of Kerry (A. G. Moore). S.W. Ireland, log 23, in thirty-five to thirty-seven fathoms, R. I. Acad. Exped., 1885; in Bantry Bay, five and a half fathoms; and in Loch Slyne, Co. Cork, in 1886. Dredged in the 'Porcupine' Expedition of 1869 in 370 fathoms off Ireland. Dredged in ninety fathoms twenty-five miles west of the Blasquet, S.W. Ireland, by Dr. Gwyn Jeffreys, May 25th, 1869, and by the same naturalist in one hundred fathoms in St. Magnus Bay. In the stomach of the haddock, St. Andrews (E. M.).

Ranges to the Mediterranean, Adriatic (Ehlers), Madeira (Langerhans), and to Norway.

Dredged in the 'Porcupine' Expedition of 1870 in eighty-one fathoms off Cape Finisterre.

Head (Plate LXII, fig. 4) forms a blunt cone, sometimes in lateral view almost ovoid, as Ehlers says. A median dorsal process with backward curve on each side occurs posteriorly.

Body small, elongated, and beautifully iridescent, tapering posteriorly to a slender tail, which in the only example of the region was devoid of cirri. Ehlers had also only incomplete examples. Few of the specimens had the bristles in a satisfactory condition, probably from friction in the net of fine gauze inside the dredge.

Proboscis.—The dental apparatus (Plate LXII, fig. 4*a*) has, superiorly, a pair of curved maxillæ which are articulated posteriorly to a process which has a short anterior region and a larger tapered posterior part as in *L. tingens*. Each of the great dental plates

Fig. 80.—Transverse section of *Lumbriconereis gracilis*.

has four strong teeth. The anterior or antero-lateral plates are two in number on each side and appear to have only one tooth in each, but as the posterior on one side has a broad edge, this, as Ehlers states, may often be double; indeed, this is well seen in one from Lochmaddy. As in allied forms their surface is granular.

The mandibles are anchylosed in front, but the edge has a V-shaped fissure, beyond which on each side the tooth presents a double crescent, viz., an inner and a larger outer. The external edge has a pigmented shelf or process.

The body-wall is typical in transverse section. The pedicle of the nerve-cords is short and the neural canal of large size. It is placed superiorly at the ganglia, but passes downward between the cords in the intervals. The ganglia are surrounded by a zone of deeply stained cells, which often form a mass inferiorly. The oblique muscles are fixed to the upper and outer borders of the investment of the neural canal.

The first foot has a small triangular posterior lobe, and a series (four) of pale spines. It bears tapering winged bristles and also jointed hooks, which in this and the second foot have a short terminal piece with a crown of small hooks and two wings, the adjacent end of the shaft likewise having two wings. The second foot has five spines.

The tenth foot (Plate LXXXII, fig. 6) is bi-papillose, a small conical papilla occurring in front and a larger obliquely conical papilla behind. Between them the fascicle of bristles projects. The tapering bristles have the usual wings, and the point is moderately attenuate. The winged hooks are jointed and have comparatively broad wings on the distal end of the shaft. In some a slight incurvation of the distal wings is evident, as in the figure. The foot has two or three pale spines.

In a mounted example dredged in Torbay, apparently referable to this species and forwarded by Major Elwes, the posterior region of the head and every subsequent segment is, in the transparent preparations, studded with large brownish-red, clearly defined pigment-cells, so far as can be observed, lodged in the hypoderm. The entire animal, with the exception of the anterior region of the snout, the segment-junctions, and the last five segments, thus has the aspect of being studded with eye-spots. Even the pygidium has a spot on each side at its anterior border.

The jointed hooks continue to the fifteenth foot and then disappear, their place being taken by simple winged hooks which at the thirtieth foot (Plate LXXXII, fig. 6 *a*) have a stout shaft and rather broad wings, whilst the terminal hook in those best developed is strong, the crown behind it having three or four erect spines in lateral view. Some of the dorsal bristles (inferior dorsal) are very attenuate towards the tip, as shown in the figure. Two pale spines occurred in the Norwegian example from which the thirtieth foot was drawn.

Several fragments, viz., from the deeper water off St. Andrews, from a depth of one hundred fathoms in St. Magnus Bay, Shetland, and from the western coast of the Isle of Man, approach this species.

The *L. coccinea* of Renier, Nardo, and Grube comes near this species.

Pruvot and Racovitza[1] term the maxilla of this and previous communications the mandible, the great dental plate maxilla 1, and the two plates in front respectively maxilla 2 and maxilla 3. The mandibles are called "labre." They give a careful account of *Lumbriconereis coccinea*, a form which comes very near *L. gracilis*, and their remarks on the dental apparatus are specially interesting.

6. Lumbriconereis G. Fragment. Plate LXII, fig. 5—head; Plate LXXIV, figs. 2 and 3 —feet; Plate LXXXII, figs. 7 and 7 *a*—bristles.

Specific Characters.—Head and body typical. The armature of the proboscis differs from that of *L. gracilis* in the marked shoulder externally on the maxillæ, and in the broader posterior appendages.

At the tenth foot the anterior border (seen in profile) forms a blunt cone, beyond which the posterior lobe appears as an irregular flap. Bristles translucent simple winged forms. Hooks, so far as the fragmentary example shows, with curved shafts dilated distally to the commencement of the wings, then tapered to the neck, the tip having a short main fang and a series of spikes above it.

Habitat.—Procured in Trawl 2, on board the 'Knight Errant' in 516 fathoms, August 24th, 1882.

[1] 'Arch. Zool. expér.,' 3e sér., t. iii, pp. 374—384.

Head of the typical conical outline (Plate LXXII, fig. 5) with a slight median inflection (backward) of the peristomial border posteriorly. The mouth has the concavity of its posterior lip directed backward, and two rounded papillæ lie in the fossa anteriorly.

Body somewhat like that of *L. brevipes*, the segments with the exception of the first two being very narrow and the posterior lobe of the foot small. The specimen is incomplete and most of the bristles are absent.

Proboscis similarly armed to *L. gracilis*, the only apparent difference being the more distinct shoulder at the posterior and outer border of the maxillæ and the proportionally broad and short posterior processes which have a boldly convex, almost semicircular outer border. The great dental plates have fourth teeth, and in front of the two anterior plates is a third granular bar on one side. An accessory granular horny belt also lies to the exterior of the great plates. The mandibles unfortunately were lost.

At the tenth foot (Plate LXXXII, fig. 7) the anterior border forms a blunt cone beyond which the posterior lobe appears as an irregular flap. The bristles consist only of one kind, viz., tapering, winged, translucent forms, but it has to be borne in mind that the specimen had lost most of the bristles and hooks. The spines are pale. In some of the feet of this form a small papilla appears above the foot, in profile, as in Plate LXXIV, fig. 2.

The general form of the elongated hooks from the middle of the body is shown in Plate LXXXII, fig. 7 *a*.

7. Lumbriconereis acutifrons, *McIntosh*, 1903. Plate LXXXVII, fig. 7—head; Plate LXXXVI, figs. 7–7 *b*—bristles.

Specific Characters.—Head tapers to a delicate extremity from a base of the normal breadth, and is rounded. Body little diminished anteriorly, and it remains of uniform diameter throughout the fragment ($\frac{3}{4}$ in.). Dental apparatus is translucent madder-brown; maxillæ somewhat broad posteriorly, with a concave border, but taper in front to strongly curved and sharp points. Their posterior appendages are constricted behind the articulation, then expand into somewhat long processes with a straight inner and a convex outer edge, the whole appendage being thus unusually long. The great dental plates appear to have six strong recurved teeth, each of which is connected by a canal with a brown band externally. A single plate with a tooth in front of these. Mandibles translucent, anchylosed in front, then split into the oblique cutting edge.

Feet project evenly, and from above present a cylindrical setigerous process, behind which is a short subulate papilla—sometimes probe-pointed—and largest in the anterior region of the body. Dorsal bristles translucent and brittle, the tips russet-brown, tapering distally to a fine point, in some considerably prolonged and winged. A few are more slender, with a hair-like tip. Hooks translucent, with the shaft curved backward distally and gradually dilating to the short neck. Main fang small, with several small teeth on the crown above it.

Synonym.

1903. *Lumbriconereis acutifrons*, McIntosh. Ann. Nat. Hist., ser. 7, vol. xii, p. 146, pl. xii, f. 29—32.

This form, dredged in the 'Porcupine' Expedition of 1870, may be briefly alluded to here, for, in the absence of a note of its locality, it may yet be procured in the neighbouring waters.

The single example is small and imperfect, but is distinguished by the attenuated conical snout (Plate LXXXVII, fig. 7), which from a base of the normal breadth tapers to a delicate extremity. In lateral view it is even thicker at the tip than when seen from above, for the dorso-ventral flattening is less marked than in ordinary types.

The *body* is very little diminished anteriorly, and remains of the same diameter as far as it goes, the total length of the fragment being $\frac{3}{4}$ in. The dental apparatus is translucent madder-brown by transmitted light. The maxillæ are somewhat broad posteriorly, with a concave border, but taper in front to strongly curved and sharp points. Their posterior appendages are constricted after the articulation, then expand into somewhat long processes, with a straight inner and a convex outer edge, the whole appendage being thus unusually long. The great dental plates appear to have six strong, recurved teeth, each of which is connected by a canal with a brown band externally. These correspond respectively with the central canal of the tooth and the layer of odontoblasts of the dental matrix of Pruvot and Racovitza,[1] as shown in their account of *Lumbriconereis coccinea*. In front the preparation presented only a single plate with a tooth. The translucent mandibles are anchylosed in front, then split into the oblique cutting edge which is capped externally with brown. Nearly parallel lines pass from these blades into the shafts, where they converge. The apparatus, however, had been injured.

In glancing along the lateral region of the body the feet are seen to project evenly, for the basal part forms, when observed from the dorsum, a cylindrical process, the setigerous lobe constituting the anterior or median region of the tip, whilst posteriorly is a short subulate papilla or lobe, sometimes probe-pointed, and which is largest in the anterior feet. The bristles are translucent and brittle, so that comparatively few remain on the specimen. The spines, of which four or more occur in the anterior feet, are also pale and translucent, the tips only being russet-brown. The dorsal bristles (Plate LXXXVI, fig. 7) are slightly curved at the end of the shaft, the winged tip dilating in the usual manner and then tapering distally to a fine point, which in some is considerably prolonged. A few bristles, again, are of a more slender structure, dilating little at the end of the shaft, and terminating in a very attenuate hair-like tip (Plate LXXXVI, fig. 7 *a*). The hooks likewise are translucent, and appear to be absent from the anterior feet, though, as mentioned, they might have been removed. The shaft is curved backward toward the tip, and gradually dilates to the commencement of the short neck of the hook (Plate LXXXVI, fig. 7 *b*). The main fang in this region of the body is small, and the crown above it has several small teeth.

The species is peculiar, and probably came from a considerable depth.

Delle Chiaje[2] gives figures of the dorsal and the ventral surface of a form with a similar sharp snout, but neither description nor name has been found, and the arrangement of the segments appears to differ. It is, at any rate, a near approach to the foregoing species from the 'Porcupine.'

[1] 'Arch. Zool. expér.,' 3e sér., t. iii, p. 380, text-fig. 3.

[2] 'Descriz. Anim. Invert.,' Tav. 178, figs. 4 and 5.

Genus LXIV. Zygolobus, *Grube*, 1863.

Head a blunt (rounded) cone. The anterior margin of the buccal segment bears two bosses which dorsally overlap the cephalic lobe. Proboscis, body, and bristles as in *Lumbriconereis*, with which this probably should be united.

Ehlers insisted that Grube's genus *Zygolobus* should be included in *Lumbriconereis*, the two swellings of the first segment, in his opinion, not sufficing for distinction.

Lumbriconereis (Zygolobus) laurentianus, *Grube*, or n.s. ? 1863. Plate LXII, figs. 6–6 *b*—head and teeth; Plate LXXXII, figs. 8–8 *c*—bristles.

Specific Characters.—Head a short cone, with two prominent dorsal bosses in the middle line posteriorly. Body 7—9 ins. in length, and fully 3 mm. in breadth, with the general aspect of a Lumbriconereid, and finely iridescent. Foot with a well-marked conical setigerous lobe having black spines (four or five in number), strong winged simple bristles with a marked curve at the distal end of the shaft above the spines, a more slender group with a different curve distally below the spines, and long winged hooks which anteriorly (twentieth foot) have a narrow and elongated distal region, but posteriorly this becomes shorter and more rounded in outline. The distal end has a narrow neck for the hook, the chief fang of which is of moderate size, and the crown above it has four or five minute spines.

The *Lumbriconereis mucronata* of Ehlers,[1] from the mouth of the Congo, has an elongated prostomium, but this is more lanceolate than acutely tapered, and the hooks of the two diverge.

Synonyms.

1863. *Zygolobus laurentianus,* Grube. Arch. f. Naturges., xxix, p. 40, Taf. ix, f. 3 and 3*a*.
1865. „ „ De Quatrefages. Annel., i, p. 382, and ii, p. 652.
1874. *Lumbriconereis laurentiana,* McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 199.
1875. „ „ idem. Invert. and Fishes St. Andrews, p. 123.
1885. „ *breviceps,* Carus. Fauna Medit., p. 215.

Habitat.—Procured in the stomach of cod and haddock from St. Andrews Bay (E. M.).

Prof. Lorenz sent it to Prof. Grube from St. Martino in Lussin Piccolo, in the Adriatic.

Head (Plate LXII, fig. 6) a short cone, and distinguished by the two prominent bosses in the middle line posteriorly.

Body probably 6 or 7 ins. or more in length and fully 3 mm. in breadth in the preparation. The general aspect is that of *Lumbriconereis*, and it has a finely iridescent cuticle. So far as the preparation shows, a single segment about twice the breadth of the others follows the head, but there are indications of two segments, as Grube says, the broader

[1] 'Deutsch. Tiefsee Exped.,' p. 95, Taf. xii, figs. 9—13.

being posterior. At the anterior border of the peristomial segment are two globular papillæ of considerable size, one on each side of the middle line of the dorsum. Grube considers them to be tentacular organs.

The proboscis, the teeth of which were not examined by Grube, is armed with a pair of much curved, dark brown maxillæ, the points of which curve dorsally in a more pronounced manner than usual in the group. Looked at from above there is, therefore, a ventral curve of the blades and a dorsal curve of the tips. Their bases are articulated posteriorly to processes which slope to a constriction, then to a fusiform and pointed region behind (Plate LXII, fig. 6 *a*). The great dental (or maxillary) plates have a small dark brown area directed vertically (dorsally) and bearing four teeth on each side. In lateral view from the outside each of these brown areas is triangular, whereas internally a rectangular process passes ventrally in the middle line. The anterior plates form a symmetrical pair on each side, the front plate being the larger, irregularly triangular, and with a single curved tooth directed dorsally. The second is also somewhat triangular, with a single tooth directed dorsally. External to the anterior plate is a horny comma-shaped patch, and on the right a horny bar curves backward from a line passing outward from the anterior border of the great dental plate and joins the pale edge of the great maxillary plate. It is incomplete on the left. The mandibles (Plate LXII, fig. 6 *b*) are pale, somewhat pointed behind, expanded and evenly rounded in front, with the exception of a small external notch, as viewed from above. On this surface they have a transverse row of black dots behind the anterior edge, and parallel lines running backward. On the ventral surface the pale *Tellina*-shaped anterior area is marked by parallel lines, which follow the outline of the double area from side to side.

The first foot presents a small setigerous lobe with three black spines, and a group of simple tapering winged bristles. The posterior lobe is large and ovate or broadly conical, for it is difficult to say what the original condition was in a specimen so softened.

The type of foot (Plate LXXIV, fig. 3, from the middle of the body) with the black spines appears to be similar in the segments behind as far as the thirtieth or fortieth. So far as the preparations go, two groups of bristles appear to be present, *e.g.*, in the tenth foot, a dorsal group of stronger, and another below the spine of bristles with shorter and more slender tips and shafts. Three or four black spines occur in the tenth foot. At the twentieth there are four or five spines, and the groups of bristles are similar. The dorsal bristles (Plate LXXXII, fig. 8) have a bold curve at the commencement of the wings, which are finely striated from the edge downward and backward. The group below the spines has more slender shafts, and the curve of the tip is bow-like (Plate LXXXII, fig. 8 *a*). One or two long winged hooks also appear in the twentieth foot (Plate LXXXII, figs. 8 *b* and 8 *c*) below the spines. The tip is dilated beyond the shaft, and the diameter of the terminal region is nearly uniform with rather narrow wings, the striæ on which, like those of the bristles, are directed from above downward and backward. It becomes narrow at the tip to form the neck of the hook, the main fang of which is of moderate size, with a crest of four or five minute spines above it.

The type of the narrow winged hook is also seen in *Lumbriconereis impatiens*, though no nuchal papillæ are present.

The anterior end of a small example was procured in the stomach of a haddock in

St. Andrews Bay by E. M. in 1869. In this specimen the two globular papillæ are situated very close together. The condition of the feet is unsatisfactory, but the setigerous region seemed to be bilobed and rather truncated at the tip. The simple winged bristles appeared to be the same as in that from the stomach of the cod. The winged hooks had shorter tips at the twentieth foot, and the first fang was hardly distinguishable in size from the small hooks above it. No black spines existed in this example, but it was much smaller than the other. The anterior hooks have a smaller main fang than in the posterior segments, indeed, anteriorly it is scarcely to be distinguished from those above it.

Delle Chiaje [1] gives a figure of a greenish form with a head somewhat like *Zygolobus*, but it has black specks at the bases of the feet. Its relationship with this form, however, is uncertain.

Grube's [2] example was 9 ins. long. He did not examine the proboscis, and his figures of the bristle and hook are too small for accurate work, and, indeed, he appears to have seen only the posterior hooks, since the contour of the terminal region is described and figured as rounded.

Claparède's *Lumbriconereis Edwardsii* ('Beobach. ü. Anat.,' 1863) approaches this species very closely, only it has compound bristles, which this has not.

The *L. tingens* of Keferstein, however, has simple bristles, but they differ from those of the British species.

From the remarks of Claparède in his 'Glanures,' [3] it would seem that the bristles and hooks of *Z. laurentianus*, Grube, are simple, and the dental armature resembles that of the author's *Z. Edwardsii*. In the other species, termed by Claparède *Z. Grubianus*, which has similar coloration to the former, each segment, however, having transverse brown striæ, the inferior hooks are articulated.

B. Eunicea prionognatha.

B. 1. Eunicea prionognatha monocopa.

Ehlers (1868) thus describes the group: Head naked, two segments without feet. Foot devoid of dorsal and ventral cirri, with simple bristles, the broad terminal wing of which is serrate. Upper jaw long and dagger-like. Five pairs of jaw-plates, accessory jaws, the first pair with hook at tip. Mandible shorter than the foregoing, each half being wide.

Genus LXV.—Drilonereis, *Claparède*, 1870.

Head and body as in *Lumbriconereis*. Proboscis with four pairs of symmetrical teeth: tooth I hook-like; tooth II declining; two maxillæ with long, slender, posterior appendages, great dental plates denticulated; mandibles wedge-shaped, and of the con-

[1] 'Descriz.,' Tav. 155, fig. 14, 1841.

[2] 'Arch. f. Naturges.,' 1863, p. 40, Taf. iv, fig. 3 and 3*a*.

[3] P. 115, pl. iv, fig. 2.

sistence of those of *Arabella*. Foot with a small dorsal lobe; winged bristles and stout spine-like bristles, both hooked and compound bristles being absent.

1. Drilonereis longa, *Webster*, 1879, *var.* elisabethæ.[1] Plate LXII, figs. 7, 7 *a* and 7 *b*—head and teeth; Plate LXXIV, fig. 4—foot; Plate LXXXIII, figs. 1 and 1 *a*—bristles.

Specific Characters.—Head a short blunt cone, with four eyes in a transverse line at its posterior border and a lunulate central mark. Body 4 or more inches long, of the shape of *Lumbriconereis*, and easily recognized by its finer and more persistent iridescence. Proboscis has powerful black, much-curved maxillæ with a broad base, having about three teeth on the inner edge, articulating posteriorly with the very long black processes. Great dental plates elongate, black and nearly rhomboidal. Each has from six to eight teeth along the inner edge. Antero-lateral plates, three, small, each with a single long, sharp fang, the posterior and larger having in addition a second small tooth at the base of the larger fang. Mandibles wedge-shaped, horny, dark brown, the anterior edge rounded and rough. Typical foot has a small dorsal lobe sloping outward and upward, a short setigerous lobe with four or five ordinary spines and a larger stout spine below the others, and a broadly lanceolate inferior lobe directed upward. Bristles simple winged tapering forms with oblique striæ on the wings.

Synonyms.

1879. *Drilonereis longa*, Webster. Trans. Albany Inst., vol. ix, p. 40, pl. vii, f. 84—88.
1885. *Laranda* „ McIntosh. Annel. 'Challenger,' p. 237, pl. xxx, f. 10; pl. xxxvii, f. 5.
1903. *Drilonereis Elisabethæ*, McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 562.

Habitat.—First procured at St. Andrews in the stomach of a haddock, in 1869, and afterwards in the stomach of the cod (E. M.). S.W. Ireland in forty fathoms; log 29, R. Irish Acad., 1885.

Shores of Virginia and New Jersey (Webster).

Head (Plate LXII, fig. 7), forming a short blunt cone, finely iridescent like the rest of the animal, and with the four eyes at its posterior border, in a transverse line. These have been omitted in the figure.

Body 4 or more inches in length, tapering slightly anteriorly and more distinctly so posteriorly. It is easily recognized amongst the other members of the group by its finer and more persistent iridescence. The colour on the dorsum consists of four longitudinal bands.

The first two segments are devoid of feet as in the other members of the group, and a lunular median mark occurs in the line of the segment-junction between them.

Proboscis.—The dental apparatus (Plate LXII, fig. 7 *a*) consists of a pair of powerful black maxillæ, massive at the base posteriorly and strongly curved in front. The broad base formed by these organs differs from that in most of the group, and especially from the condition in *Lumbriconereis* and *Eunice*. The two halves touch in the middle line posteriorly and articulate with the V-shaped end of the very long posterior black

[1] Named after the lady who found it.

processes. Moreover, the inner edge of the base is furnished with teeth, three of which are visible in front. The great dental plates are elongate, black, and nearly rhomboidal. They have about six recurved teeth along the inner edge besides a considerably larger first fang. The small antero-lateral plates are three in number, each with a long sharp fang, the largest, in addition, having a small tooth at its base, and thus the arrangement materially differs from that of *A. iricolor*, which has in each plate five or six teeth. The mandibles (Plate LXII, fig. 7 *b*) are dark brown, horny, and wedge-shaped. The broad anterior edge is rounded and roughened. A slight slope occurs on the inner edge of each, running to the point of contact of the halves.

The first foot forms a simple conical lobe, without marked indication of the process for the bristles as in the second and subsequent feet. It bears a group of simple tapering winged bristles. Very soon a dorsal process or papilla appears, so that at the sixth foot it forms a prominent structure in certain views (Plate LXXIV, fig. 4). The typical foot has a similar outline, viz., a small dorsal lobe sloping outward and upward, a short setigerous lobe projecting straight outward, and a broadly lanceolate inferior lobe directed upward and backward, its longer outline being inferior. Four or five spines support the foot anteriorly (tenth); five occur at the thirth-seventh, and posteriorly four or five are present, in addition to a large stout spine, apparently below the others, the tip of which (enclosed in the tissues) is pointed (Plate LXXXIII, fig. 1) and solid. It is a brittle, chitinous structure like the teeth and gives way when compressed. The great strength of this spine in contrast with the others is noteworthy, and apparently its function is similar to the great hooks of the Eunicidæ. The bristles (Plate LXXXIII, fig. 1 *a*) are simple—tapered and winged—with moderately long points, and have the usual oblique striæ on the wings. The dorsal are somewhat stronger than the ventral. In glancing along the feet anteriorly the prominent lobe is seen to be ventro-posterior in position.

Habits.—This species seems to inhabit sand or sandy mud at the bottom, yet the number of specimens procured in the stomach of the haddock by my mother seems to indicate that it occasionally leaves its retreats to crawl about on the bottom, or even to swim in screw-coils over it, though it may also be ejected by storms.

This form seems to be closely allied to the *Drilonereis* (*Laranda*) *longa* of Webster, from the Virginian coast and New Jersey. Discrepancies may be due to imperfections in description. The example procured by the 'Challenger' was obtained off the American coast between Halifax and New York. The British form differs in the larger size of the dorsal process and in the presence of eyes, but it has been thought unnecessary to constitute a new species.

Genus LXVI.—Arabella, *Grube*, 1851.

Conical head devoid of appendages, but with eyes. Body with two footless segments anteriorly,[1] and finely iridescent. Terminal segment bilobate. Four anal cirri. Proboscis with two strong maxillæ; a great dental plate and three others on each side, the two anterior having long, sharp teeth. Mandibles short with wide anterior plates. The

[1] Grube terms the buccal segment biannulate, the second produced inferiorly to the mouth.

dental apparatus is symmetrical. Foot with a small dorsal lobe sloping outward and upward, a short setigerous division, and a lanceolate inferior lobe. Besides the ordinary spines is a specially strong pointed spine of a brittle nature. Bristles simple, winged, and tapering.

Grube (1879) apparently makes three genera of this, viz., *Arabella*, Grube; *Aracoda*, Schmarda; and *Maclovia*, Grube; the first being distinguished by the presence of four pairs of jaws, whilst the others have five, thus forming two distinct groups. Both groups are stated to have jaw I hook-like, but *Arabella* has the base serrated, all the jaws toothed, jaw II asymmetrical (Ungleich), two maxillæ, and a rudimentary dorsal cirrus. On the other hand Grube gives to *Aracoda* of the second group a single buccal segment, two maxillæ (Kieferträger), and according to Schmarda jaw II is symmetrical; whilst *Maclovia*, Grube, has jaw II asymmetrical, as in *Arabella*, and three maxillæ (Kieferträger). Considerable confusion, therefore, was introduced into this group by the distinguished naturalist, probably from relying on erroneous descriptions.

Ehlers, in his 'Florida Anneliden' (1887), follows Grube's diagnosis, and places under *Aracoda* those in which the bases of the maxillæ are dentate.

Arabella iricolor, *Montagu*, 1804. Plate LIV, fig. 4; Plate LXII, figs. 8–8 *c*—head and teeth; Plate LXXIV, figs. 5–5 *c*—feet; Plate LXXXIII, figs. 2 and 2 *a*—bristles.

Specific Characters.—Head somewhat flattened, bluntly conical, and with four eyes, one on each side of the middle line, and very slightly in front of the others, which are external and less conspicuous. Body 8 ins. to a foot long, firm, rounded, often thrown into a spiral, and of an iridescent pinkish colour with a tinge of reddish from the blood-vessels. It tapers posteriorly to a tail, which has four short cirri—two somewhat longer dorsally, and two ventrally. First two segments evenly rounded, but the feet cause a lateral dimple in the others. First segment narrower than the second dorsally. Proboscis with maxillæ strongly curved and massive at the base, which is articulated with two tapering processes, the narrow posterior end joined to two long parallel blackish rods, which gradually diminish posteriorly and end in slight enlargements. The great dental plates have nine or ten recurved teeth. First antero-lateral plate has five teeth, the two anterior far surpassing the rest in size. The posterior has the same number of teeth, the first and third being largest. Mandibles cleaver-shaped, black, with a pale tip and an oblique cutting edge of considerable length. The posterior process commences after an abrupt shelf.

The foot has a small dorsal lobe above the setigerous process and a larger lower lobe. At the tenth foot the row of bristles passes from above downward and forward—below the upper and in front of the posterior lobe. This continues to the tail, where the line of the bristles is less oblique and the setigerous lobe more prominent. The bristles are of two kinds: (1) a dorsal series with a gentle curve and long, finely tapered tips with narrow wings, and (2) a series with shorter tips which have a more abrupt curve at the end of the shaft, the free edge of the curve having about five serrations. Anteriorly the foot has from five to seven spines, and by-and-by the dorsal region has a group (four

or five) of small spines which pass to the base of the cirrus. Posteriorly this dorsal group increases in size.

Synonyms.

1804. *Nereis iricolor,* Montagu. Trans. Linn. Soc., vii, p. 82.
1807. „ „ Turton. Brit. Fauna, p. 135.
1812. „ „ Pennant, Brit. Zool., ed. 4, iv, p. 94.
1828. *Lumbricus Saint-Hilaire,* Delle Chiaje. Memorie, iii, pp. 170, 178, Tav. xlii, f. 4, 11, 16.
1836–7. *Œnone maculata,* M. Edwards. Règne Anim., pl. xi, f. 4.
1840. *Lumbriconereis quadristriata,* Grube. Actin. Echinod., etc., p. 79.
1841. *Lumbrinereis S.-Hilairii,* Delle Chiaje. Descriz., iii, p. 83 ; v, p. 97, Tav. 96, f. 4, 11, 16.
1851. „ (*Arabella*) *quadristriata,* Grube. Fam. Annel., pp. 45 and 124.
1861. *Aracoda cærulœa,* Schmarda. Neue Wirb. Thiere., I ij, p. 115, Tab. xxxii, f. 253.
1864. *Lumbriconereis quadristriata,* Grube. Insel Lussin, p. 80.
1865. *Lumbrinereis maculata,* De Quatrefages. Annel., i, p. 365.
„ „ *quadristriata,* idem. Ibid., i, p. 366.
„ „ *gigantea,* De Quatrefages. Ibid., i, p. 360.
„ *Nereis iricolor,* idem. Ibid., p. 383.
„ „ *tricolor,* Johnston. Cat. Worms Brit. Mus., pp. 142 and 341.
„ „ *iricolor,* idem. Ibid., p. 280.
1867. „ „ Parfitt. Trans. Devon. Assoc., ii, p. 20 (sep. copy).
1868. *Arabella quadristriata,* Ehlers. Borstenw., pp. 399 and 405, Taf. xvii, f. 15—24.
„ *Lumbriconereis* (*Zygolobus*) *quadristriata,* Claparède. Glanures, p. 116, pl. iv, f. 5.
„ *Notocirrus Hilairii,* idem. Annél. Nap., cl, pl. ix, f. 4.
1871. *Maclovia gigantea,* Grube. Jahresb. Schles. Ges., p. 58.
1872. „ „ idem. Mitth. u. St. Malo, etc., p. 86.
1875. *Notocirrus tricolor,* Ehlers. Zeitschr. f. wiss. Zool., xxv, p. 56, Taf. iii, f. 33.
„ *Arabella quadristriata,* De St. Joseph. Ann. Sc. nat., 6e sér., t. ii, p. 16.
1878. *Lumbriconereis iricolor,* Grube. Jahresb. Schles. Ges., 1878 ; Breslau, 1879, p. 87.
1879. *Maclovia gigantea,* idem. Ibid., p. 104.
1881. *Arabella Hilairii,* Langerhans. Canar. Annel. in Nova Acta Leop., xlii, p. 112.
1885. *Notocirrus capensis,* McIntosh. Annel. 'Challenger,' p. 236, pl. xxxvii, f. 3 and 4; pl. xviiiA, f. 15.
„ „ *Hilairii,* Carus. Fauna Medit., p. 216.
1888. *Maclovia gigantea,* De St. Joseph. Ann. Sc. nat., 7e sér., t. v, p. 30, pl. ix, f. 92—95.
1898. „ „ idem. Ibid., 8e sér., t. v, p. 282.
1900. „ *iricolor,* Willey. Journ. M. B. A., n.s., vol. vi, i, p. 98.
1903. *Arabella* „ McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 563.
1905. *Notocirrus hilarii,* Graeffe. Arbeit. Zool. Stat. Triest, xv, p. 322.
1906. *Arabella St. Hilarii,* De St. Joseph. Ann. Sc. nat., 9e sér., t. iii, p. 214, pl. iv, f. 82.
„ *Maclovia gigantea,* Bohn. Ibid., 9e sér., t. iii, p. 101.
1909. *Aracoda iricolor,* Banham. Polych. Subantarctic Is., N. Zealand, p. 245.

Habitat.—Abundant under stones between tide-marks at St. Peter Port, Guernsey, and at Herm, whence it was first sent to me by Sir Ray Lankester. It is also common on the southern shores of England. It seems for the most part to frequent the tidal region both at home and abroad. West Coast of Ireland. Off Galway in fifteen to twenty fathoms, 'Porcupine,' 1869. Bantry Harbour, R.I.A. Exped., 1885.

Shores of France (De St. Joseph) ; Naples (Delle Chiaje) ; Canaries (Langerhans) ;

South Africa; Japan; Juan Fernandez; Straits of Magellan. May yet be found on the American shores.

Head slightly flattened from above downward, bluntly conical, and of the same pinkish iridescent hue as the rest of the body. It is distinctly separated from the peristomial segment both dorsally and ventrally. At the posterior border it bears four eyes, one on each side of the middle line, and very slightly in front of the others, which are lateral and less conspicuous. The under surface of the snout (Plate LXII, fig. 8) has a longitudinal furrow, probably in connection with the eversion of the proboscis. The mouth opens just behind the prostomium. Two well-marked furrows pass backward from the oral border on each side of the median line, and there is a shorter lateral one.

Body 8—10 ins. long, and with 178—200 or more segments, firm, rounded, often thrown into a spiral. The first two segments are evenly rounded, whereas in the succeeding the feet cause a dimple at the side of each. The first segment is narrower

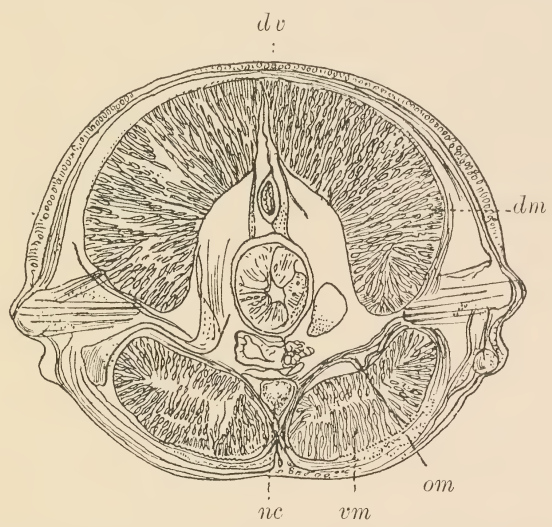


FIG. 81.—Transverse section of *Arabella iricolor*, about the anterior third. The nerve-cord has been pushed inward by the largely developed ventral longitudinal muscles. Letters as before.

than the second dorsally, but broader ventrally, and proportionally deeper anteriorly. The body is slightly tapered in front, and more distinctly so posteriorly toward the tail, which has the anus at the tip, a kind of funnel being formed by the four short cirri, the tips of which are nearly on a level (Plate LXII, fig. 8*d*).[1] The general colour is iridescent pinkish, with a tinge of reddish here and there from the blood-vessels.

The *proboscis* is armed with a series of five brownish-black teeth (Plate LXII, figs. 8*a*, 8*b*). The maxillæ are short, strongly curved, and massive at the base, the inner edge of which is denticulated (eight and nine points). Behind are two tapering processes with an enlargement immediately behind the maxillæ, then a contraction, followed by another enlargement with a spur, the narrow end being continuous with two long parallel blackish rods, which gradually diminish posteriorly and end in slight enlargements. The great dental plates have each eight or ten recurved teeth. The antero-lateral plates are situated on each side of the middle line in front of the maxillæ. The posterior plate has four to five well-marked recurved fangs, the first and the third being

[1] Reference to this figure has been omitted in the description of the plate.

larger. The plate in front has the same number of teeth, but the anterior far surpasses the rest in size. The small anterior tooth has a single large curved fang. The mandibles (Plate LXII, fig. 8 *c*) are cleaver-shaped, black, with a pale tip which forms an oblique cutting edge sloping outward from the point of attachment. The body of each process is long, and the short and narrow posterior process commences after an abrupt shelf.

In transverse section (Fig. 81) the cuticle is dense, and the hypoderm proportionally well developed. The longitudinal muscles are massive, the dorsal exceeding the ventral in size, only a chink separating them in the mid-dorsal line, and the dorsal vessel is thus (in contraction) pushed far inward. The oblique muscles are powerful, and are attached to the upper and outer border of the nerve-area, the vertical bands from the alimentary canal being inserted at the same points. The nerve-area has a long pedicle furnished with many blood-vessels, and in contraction is somewhat ovoid, no neural canal being visible.

The first foot (Plate LXXIV, fig. 5) is of considerable size, and consists of a small dorsal lobe above the setigerous process, and a large lower lobe (posterior and tongue-shaped in lateral view) which has a slight slant backward. The row of bristles in this foot is less oblique than in the subsequent feet, being situated between the dorsal cirrus or lobe above and the large ventral lobe beneath. At the tenth foot (Plate LXXIV, fig. 5 *a*) the bristle-row passes from above downward and forward below the upper lobe, and in front of the posterior lobe. This arrangement continues throughout the greater part of the body, only posteriorly at the tail the line of the bristles is somewhat less oblique, and the spinigerous lobe more prominent. The tenth foot has only bristles of one kind, viz., tapering winged bristles, and while the dorsal lobe or cirrus is of considerable size the large posterior lobe is less than it becomes in the succeeding feet. The points of many of the developing bristles project from the foot at the base of the long bristles, which appear to be brittle. The bristles (Plate LXXXIII, figs. 2 and 2 *a*) are of two kinds, (1) a dorsal series with a gentle curve and rather long, finely tapered tips with narrow wings, and (2) a series with shorter tips which have a more abrupt curve at the end of the shaft, the wings opposite the curve being expanded and provided with about five serrations.

The foot has from five to seven spines anteriorly, and by-and-by the dorsal region has a group of small spines which go to the base of the cirrus. In the posterior feet this dorsal group of spines is considerably larger, though they do not attain the size of the inferior series. There are four or five in the upper group.

The foot in the middle of the body (Plate LXXIV, fig. 5 *b*) diverges little from the tenth, except in the form of the dorsal cirrus, which becomes a mere papilla. The long posterior lobe curves upward behind the setigerous process, but is not longer than in front. The hypodermic cells are regularly arranged, and the whole process is highly vascular.

The posterior feet (Plate LXXIV, fig. 5 *c*), again, present a dorsal cirrus somewhat smaller and more tapered than in front, whilst the curved posterior lobe is slightly shorter than in the middle of the body.

The feet continue prominent, though the body tapers to the tail, two or three immediately in front of the pygidium being minute. Dorsally over the vent are two cirri,

thicker than those beneath, and having a distinct cirrophore or enlargement at the base, from which the cirrus comes off at a slight angle as it slopes outward, the tip in the preparations being blunt. The ventral cirri are somewhat more slender than the dorsal and a little shorter. By separating the sides of the vent the dorsal and ventral cirri of each side are found to be attached to the same basal flap. The caudal segments would appear to be frequently regenerated.

Reproduction.—A dark-coloured specimen in a firm tube of small stones and shell-fragments under a stone in a littoral pool at Herm in July was filled with ova, which escaped apparently by pores (?) near the feet, especially towards the posterior half.

Habits.—It is active and vigorous when stimulated, and is fond of twisting its body into coils. It tinges spirit of a deep pinkish hue, then of a fine purple. In some instances the animal is preserved in a firm spiral like a wire-spring.

It is difficult to diagnose the precise form mentioned and figured by Donati [1] from an Alcyonium in the Adriatic. It may be either this form or a *Lumbriconereis*.

This is one of the striking British forms procured on the shores of Devon by the indefatigable Col. Montagu, who in 1804 described an example as thick as a raven's quill in diameter and 3 feet long. It is the *Nereis iricolor* of his MS. volume of drawings (Plate XXXII, fig. 3, 1808) by his niece, Miss Dorville.

In the illustrated edition of the 'Régne Anim.' (1836—7) four striæ are distinctly shown, two stronger lateral, and two less marked on each side of the middle line of the dorsum.

Grube (1840) gave this form only two eyes.

There is some doubt as to whether Delle Chiaje's *Lumbricus Saint Hilaire* (1842) is this species, for the four longitudinal series of spots, the two conspicuous eyes, and the figure of the dental apparatus differ, yet it can hardly be anything else.

The *Lumbriconereis longissima* of Grube [2] from Valparaiso is a form very nearly related to this species, if it is not the same.

The *Aracoda cærulea* of Schmarda [3] from the coast of Chili, Juan Fernandez, and other localities, seems to be very closely allied, if not identical, the slight changes in the dentition and other parts being probably due to variation, and these remarks are rendered more probable by the perusal of the description and figures of Ehlers.[4]

Claparède (1868) associated Delle Chiaje's species with Grube's and subsequent authors', and thought that the differences in coloration might be surmounted, some being boldly marked with spots, others, as in those from the Channel Islands, being without them. The very wide distribution of this form gives a margin for considerable variation.

Ehlers (1868) points out that Grube in his original description mentioned only two eyes, and omitted the dorsal cirrus. He also corrects the synonymy.

The *Notocirrus geniculatus* of Claparède (1875), as described by Marion and Bobretzky,[5] does not seem to differ materially from this species.

[1] 'Della Storia Nat. Mar.,' p. 60, Tav. viii, figs. G—K, 1750.

[2] 'Annulat. Œrsted in Naturhist. Foren. Vidensk. Meddel.,' 1857, p. 158 (p. 1 sep. copy).

[3] 'Neue Wirb. Thiere,' ii, p. 115, 1861.

[4] 'Polychæt. Magell. u. Chilen.,' 1901, p. 143, Taf. xix, figs. 1—6; and 'Zool. Jahrb.,' suppl. "Fauna Chilen," ii, 1901, p. 263.

[5] 'Ann. Sc. nat.,' 6e sér., t. ii, p. 15, pl. i, fig. 2.

Grube in 1871 instituted the genus *Maclovia* for De Quatrefage's *Lumbriconereis gigantea*, and in his later publication (1879) adheres to the genus, distinguishing it from *Arabella* by the presence in the latter of only four pairs of jaws. In *Maclovia*, again, Grube assigned four large basal teeth to the first pair of jaws (Kieferpaares), whereas in such forms as Verrill's *Arabella opalina* the four basal teeth of the first pair are small.

The *Arabella opalina* of Verrill, which Treadwell[1] also found at Porto Rico, seems to be a closely related form common on the American coast, where formerly Leidy termed it *Lumbriconereis splendida*.[2] Webster and Benedict found it at low water in sand.[3]

The note on the synonymy of this species by Dr. Willey, 1900, did good service in drawing attention to the confusion on the subject, especially in connection with the supposition that *Notocirrus scoticus*, McI., was the same species. The two forms are readily discriminated by the naked eye.

Genus LXVII.—Notocirrus, *Schmarda*, 1861. *Char. emend.*

Head rounded and devoid of appendages. Eyes present or absent. Body firm, of moderate length, deeply segmented so as to be more or less moniliform. Maxillæ with long fangs; four pairs of jaw-plates, the first with uniformly toothed edge, the second dissimilar; very long posterior processes. Mandibles pointed posteriorly. Foot with a stumpy rounded dorsal and ventral cirrus. Bristles simple, with short tips and broad wings.

Ehlers[4] describes this genus as having a rounded naked head. Foot with a stumpy rounded dorsal and ventral cirrus, simple bristles with sparsely toothed wings. Upper jaw with long fangs, four pairs of jaw-plates, the first with uniformly toothed edge and without end hook, the second dissimilar.

Claparède (1868) observed that De Quatrefages considered the absence of eyes diagnostic, yet two species he described were furnished with four. Then he did not think the presence of a dorsal cirrus of much differential weight in connection with *Lumbriconereis*. On the other hand, the cirrus or tubercle sometimes representing it always had a group of small spines. These are absent in the Lumbriconereids. He evidently included *Arabella* as a chief type, and thus his views differ from those in the present work.

1. Notocirrus scoticus, *McIntosh*, 1869. Plate LXII, figs. 9–9 *b*—body and teeth; Plate LXXIV, figs. 6 and 6 *a*—feet; Plate LXXXIII, fig. 3—bristles.

Specific Characters.—Head acutely conical with two distinct eyes at its posterior border. Body about 3 ins. long, of a general reddish-brown colour, and less iridescent

[1] 'Journ. Acad. Nat. Sc. Philad.,' vol. iii, p. 147.

[2] 'Rep. U. S. Comm. F. and F.,' 1884, p. 721; and Webster, '32nd Ann. Rep. N. York Mus.,' p. 116, 1879.

[3] 'Rep. U. S. Comm. F. and F.,' 1901, p. 199.

[4] 'Borstenw.,' ii, p. 406, 1868.

than *Lumbriconereis fragilis*. It has a moniliform or deeply segmented appearance, the enlargements occurring at the feet. It diminishes to a tapering tail posteriorly. The typical foot has a small dorsal lobe (cirrus) in which is a single vascular loop. Setigerous region beneath is supported by two strong spines, and the brittle bristles have comparatively short, broadly winged tips, boldly serrated at the edges. A small lobe or papilla also appears ventrally.

This genus was included under the eighth family of Kinberg's Eunicea (Laidea),[1] and was characterized by the presence of an entire cephalic lobe, devoid of eyes. Branchiæ (cirri dorsuales) and ventral cirri mamilliform.

Synonyms.

1869. *Notocirrus scoticus*, McIntosh. Trans. Roy. Soc. Edinb., vol. xxv, p. 417, pl. xvi, f. 17, *a*, *b*.
,, ,, ,, idem. Rep. Brit. Assoc. (1868), p. 337.
1903. ,, ,, idem. Ann. Nat. Hist., ser. 7, vol. xi, p. 564.

Habitat.—Dredged in tenacious grey clay in nine fathoms in Ardmaddy Bay, Loch-

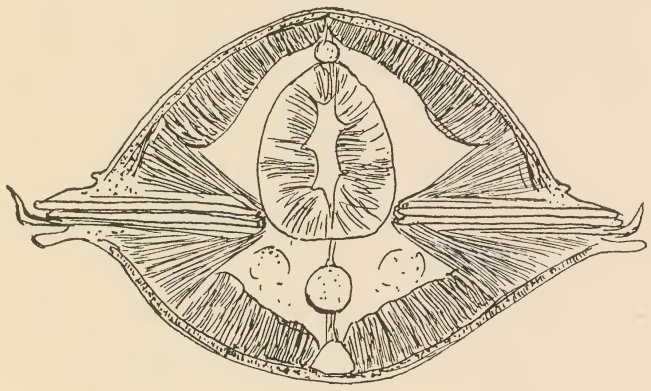


Fig. 82.—Transverse section of *Notocirrus scoticus* about the anterior third.

maddy, North Uist, in 1865 (W. C. M.), and subsequently in several parts of the Hebridean seas by that veteran naturalist, the late Dr. Gwyn Jeffreys. Also in 100 fathoms in St. Magnus Bay (J. G. J.). Irish Sea off Peel, July, 1879 (W. C. M.). It was met with in the 'Porcupine' Expedition of 1869 in 80—110 fathoms in muddy sand with pebbles.

Head (Plate LXII, fig. 9) acutely conical, with two distinct eyes at its posterior border, where it is slightly contracted. The eyes are rather close to each other on each side of the middle line. It is somewhat flattened from above downward in lateral view. Ventrally a median depression goes forward from the mouth toward the tip of the snout.

Body about 3 ins. in length, of a general reddish or reddish-brown colour, less iridescent than *Lumbriconereis fragilis*. It is slender, tapered a little at the anterior end, which has the segments more compactly arranged and generally thicker, diminishing posteriorly. The greater part of the body has a moniliform or deeply segmented appearance, the enlargements occurring at the feet. The cuticle is tough and minutely punctate, from the presence of the apertures of what appear to be minute tubes, which, when the cuticle is torn off, project internally as slender structures like hairs.

[1] 'Öfvers. Kongl. vet. Akad. Förhandl.,' 1864, p. 571.

The first two segments are scarcely so broad as the succeeding, and with the following six or seven are more rounded (as in *Lumbriconereis*) than those behind, which present a deeper sulcus at the segment-junction. Behind the thirtieth foot the body becomes moniliform, the lateral body-wall projecting outward like a cone with the foot at the tip. The anterior segments, moreover, have longer bristles, and the tips of these are more finely tapered than in the region behind.

Only one example had a tail, and that had recently been regenerated. No distinct papillæ occurred at the tip, though the minute size of the part and the absence of feet on the segments showed that it was only in process of growth.

Proboscis.—In *Notocirrus*, as in *Cirrobranchia*, Ehlers, a considerable modification of the dental apparatus has occurred (Plate LXII, fig. 9 *a*). The maxillæ are no longer prominent and might easily be overlooked. They form small toothed processes in the usual position, with two to four curved fangs and an enlarged base, the thicker edge of which touches the enlarged anterior ends of the posterior appendages. Some would consider them merely continuations of the series of dental plates which lies in front of them, but in all probabitity the foregoing is the more satisfactory interpretation, unless it is to be supposed that the maxillæ are entirely absent. The posterior appendages have an enlargement at the articulation, and a spur a short distance downward, and then form two long tapering processes. In front of the maxillæ are three dental plates. The posterior is the largest, and has a dark blackish-brown colour, with several large teeth in front, and an inner long process, which passes backward to the base of the maxillæ, bearing smaller recurved teeth. Externally about the anterior hook of the maxillæ it has a well marked process or shoulder. The plate in front also has a posterior process or shoulder, and six or seven teeth on its inner edge. The anterior plate is still smaller and shows six well marked teeth. Each of these plates is supported by a thin plate, which passes inward and ventrally.

The mandibles (Plate LXII, fig. 9 *b*) form two dark brown processes with a crenate anterior edge which is slightly bevelled. Behind is a constriction externally, the outline curving outward again and then inward to the slightly tapered posterior end. The two limbs (that is, the posterior processes) enclose a wedge-shaped space between them, and the edge along which they touch in front is nearly straight. It is marked by a slight shoulder posteriorly.

The typical foot (Plate LXXIV, fig. 6) has a small dorsal lobe (cirrus ?) in which is a single vascular loop. The setigerous region beneath is supported by a pair of strong spines, the points of which often project beyond the surface. The bristles (Plate LXXXIII, fig. 3) are very brittle, and have comparatively short tips with wings, which are broad and boldly serrated at the edges throughout the greater part of their length. Foreign particles thus adhere very readily to them and obscure their structure. A small lobe or papilla (Plate LXXIV, fig. 6 *a*) also exists ventrally, so that the conical foot has two, a dorsal and a ventral, as in *Arabella tricolor*.

The *Gordius pusillus* of Delle Chiaje[1] would seem to refer to this or a very closely allied species.

[1] 'Mem.,' iv, pp. 177, 196, Tav. lxiv, figs. 8 and 9, 1829; and 'Descriz.,' iii, p. 82; v, p. 97, 1841.

2. Notocirrus, sp.

Synonym.

1903. *Notocirrus* sp., McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 565.

Another small and very active species was procured under a stone in a tide-pool at Herm, but unfortunately it has been lost. The head was smoothly rounded in front, and of a brighter reddish-orange than the rest of the body, which was dark orange, with the dorsal blood-vessel in the centre. The segments appeared to be minutely granular as if punctured. The tail terminated in two longer and two shorter papillæ.

Sub-Family Onuphididæ.

Kinberg[1] made the Onuphæa the first family of his Eunicea, characterized by having seven maxillæ, part Ii edentate, tentacles five, antennæ two, palpi two, and a single buccal segment. He grouped the genera according to the condition of the branchiæ, which are plumose in *Diopatra*, pectiniform or cirriform in *Onuphis*.

No example of the genus *Diopatra*, a southern type, has hitherto been met with in

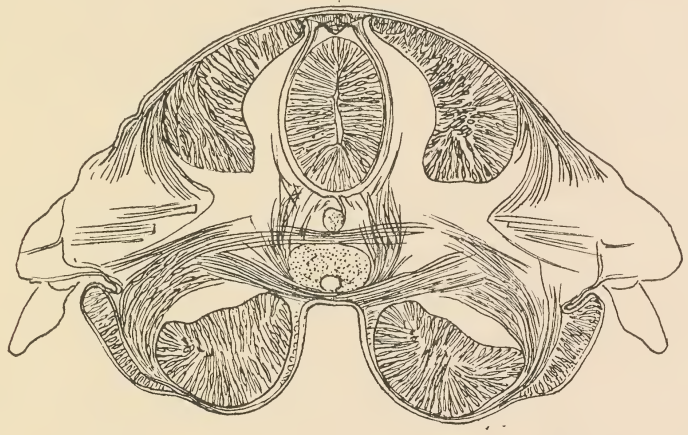


Fig. 83.—General arrangement of the muscles in the body-wall of *Hyalinœcia tubicola*, O. F. M. × 21. The vertical bands of fibres passing by the sides of the nerve-cords to the sides of the alimentary canal are diminishing. The single large neural canal toward the ventral edge of the nerve-cord is conspicuous. The oblique muscles arise inferiorly at the sides of the nerve-cord.

British waters, though it may yet be found in the neighbouring parts of the Atlantic. As Claparède points out, the existence of eyes is not general.

Grube[2] followed Savigny in grouping the Onuphidæ under the Eunicea.

The Onuphidæ follow the Eunicidæ in Levinsen's classification (1883), and apparently with good reason, and Benham likewise includes the group under the Eunicidæ.

Häcker (1896)[3] quotes Wilson as alluding to a stage of *Diopatra cuprea* with five segments, and this is a non-pelagic larva, bred in the gallery where the eggs are laid. He gives a detailed account of the histology of the pelagic and other larvæ.

[1] 'Öfvers. af. K. Vet.-Akad. Förh.,' 1864, No. 10, p. 559.

[2] 'Fam. der Annel.,' p. 44, 1851.

[3] 'Zeitschr. f. wiss. Zool.,' Bd. lxii, p. 98.

Remarkable tubes are formed by several foreign examples of the group, such as those of *Onuphis sombreriana* of the 'Challenger,' which utilizes the long glassy spicules of vitreous sponges, and *O. Willemœsii*, which secretes a finely rounded tube bristled with long spines of similar material. The Onuphididæ are distinguished by their bathymetrical distribution, for almost all occur in water of considerable depth, and many range to very great depths, *e.g.*, 2225 fathoms. Not a few of the Eunicids and Lumbriconereids, on the other hand, frequent shallow water.

In this group reproduction of lost parts has been noted several times in *Diopatra* by De Quatrefages, Ehlers, Fauvel, and others.

Genus LXVIII.—Onuphis, *Audouin and Edwards*, 1834.

Head bearing two eyes and seven tentacles, arranged in three rows—two in front, two in the middle, and three in rear. Buccal segment with two tentacular cirri. Dental apparatus highly developed. Branchiæ pectinate or simple.[1] Bristles in front large falcate, bifid forms; then the foot has simple winged and tapering upper bristles, with a few brush-shaped forms, and inferiorly powerful bifid winged hooks.

1. Onuphis britannica, *McIntosh*. Plate LI, figs. 6 and 6 *a*; Plate LXIII, figs. 7–7 *d*—head, teeth, tube; Plate LXV, fig. 13—double maxillæ; Plate LXXV, fig. 5—foot; Plate LXXXIV, figs. 3–3 *c*—bristles.

Specific Characters.—Head typical, with well-marked black eyes, situated external to the base of the long lateral tentacles. First segment about half the breadth of the succeeding, and having two subulate tentacular cirri which arise from the centre of the segment. First pair of feet project forward almost to the anterior border of the snout, and bear falcate bristles (bifid tips) furnished with wings, whilst dorsally are simple tapering bristles. At the third foot are the latter and brush-shaped bristles dorsally, and ventrally the falcate bristles. The filiform branchiæ commence from the eighth to tenth foot, in which latter the ventral cirrus is in the form of a boss or pad, and continues to the tip of the tail. In the same foot the setigerous region is bluntly conical, with a stout papilla projecting in front of the bristles at the tip, and a long subulate papilla behind them. Dorsally are simple bristles, finely tapered at the tip, but with broad wings, and a few brush-shaped bristles. Beneath is a single long bifid hook with wings. At the twentieth foot the branchia absorbs the entire basal region, the small, slender cirrus appearing as a process of this organ. The bristles are slightly modified posteriorly, but the hooks retain almost the same structure. Tubes formed of tough secretion, strengthened by numerous pieces of bivalve shells.

Synonyms.

1870. *Nothria conchylega*, Baird. Journ. Linn. Soc., vol. x, p. 356 (*partim*).
1903. *Onuphis britannica*, McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 555.

[1] In the 'Camb. Nat. Hist.,' ii, p. 319, 1896, the branchiæ are described as pectinate (Benham).

1904. *Onuphis conchilega,* Allen. Journ. M. B. A., N.S. vol. vii, p. 225.
? 1905. „ *conchylega*, Willey. Rep. Ceylon Pearl Fisheries, iv, p. 276.

Habitat.—Dredged by Dr. Gwyn Jeffreys in 100 fathoms, St. Magnus Bay, and 90 fathoms off North Unst, Shetland, in 1867. Dredged thirty to fifty miles W. of Valentia in 90—125 fathoms and in Donegal Bay (J. G. J.); in ninety-two fathoms on Adventure Bank in sandy mud, 'Porcupine,' 1870. Ceylon ? Dr. Willey identifies the Ceylonese species with that at Plymouth, so that in all probability they agree. S.W. Ireland, Stat. I, 1885, log 3, forty-five fathoms; Stat. VII, ditto, twenty-two fathoms, 1890 (12th May); S.W. Ireland, ditto, Stat. I, log 3; eighty fathoms, R. Irish Acad. Exped., 1885, Plymouth, as *O. conchilega*, (Allen).

Head (Plate LXIII, fig. 7) with two small lobate frontal tentacles on each side of the middle line, and five long tentacles, the median, as in *Eunice*, being longest and the inner lateral much exceeding the outer in length. Each arises from a ringed cirrophore. The median is most posterior, and the longer lateral springs behind the shorter. A well-marked black eye occurs to the exterior of the base of the long lateral, and occasionally a black speck lies in front of the median. On the ventral surface are two flattened palpi, separated by a median fissure, and projecting laterally rather than anteriorly.

The *body* is tapered in front and more distinctly so posteriorly, and has forty-two or more bristled segments, and therefore is much shorter than in *Hyalinœcia*. The peristomial segment is about half the breadth of the succeeding, and bears dorsally two subulate tentacular cirri which arise from the centre of the segment, and at the base of each externally is a black speck. A similar black speck occurs on the next and is distinct on the following eight or nine segments—gradually fading after the commencement of the branchiæ. The segment following is broad and carries the large first pair of feet, which project in the preparations forward almost to the anterior border of the snout. The next feet are also large but they gradually diminish. The body is somewhat rounded dorsally, especially in front, and has a deep ventral groove. The general colour, in life, is pale brownish with an iridescent lustre, the pigment being darkest in front and along the median line, which is also marked by the dorsal vessel. A tinge of yellow occurs at the tail, and the branchiæ are red. The head and tentacles are yellowish. The body terminates posteriorly in two caudal cirri arising beneath a dilated anus.

Proboscis.—The dental apparatus (Plate LXIII, fig. 7 *a*) is pale with a slight tinge of chocolate, also with dark chocolate bands on the edges of the maxillæ and dental plates and in the form of an English cross at the posterior appendages. The maxillæ are broad posteriorly and narrow in front, with a sharp tip. The right great dental plate has eleven or twelve teeth, the first being most prominent and hooked. The left has ten teeth, but from a hiatus one appears to have been broken. The left azygos has ten teeth. The right anterior curved plate has ten or eleven teeth, and the left about the same number. The posterior appendages taper backward from a somewhat broad base so that they are more or less triangular. The mandibles (Plate LXIII, fig. 7 *b*) have long tapering shafts, and the somewhat narrow dental edge has a few points. A dark spot occurs at the shoulder externally, and in some an angular

or stellate black mark is found toward the inner edge of each dental plate. Certain differences exist between the foregoing and that figured in the 'Challenger'—it may be from difference in age. In one example the maxillæ had been reproduced (Plate LXV, fig. 13), both sets being visible in the preparation. No sign of duplication in the posterior appendages is present.

The first foot is long and slightly tapered—with a bulbous extremity—bearing a subulate dorsal cirrus about its middle dorsally, and having toward its tip dorsally a long and rather stout papilla. A stout subulate process (ventral cirrus) occurs near the base ventrally. The foot is supported by a series of strong yellow spines, and, though the tip of only one bristle projects beyond the skin, others are included in the tissues. These consist of large falcate bristles with bifid tips, furnished with wings (Plate LXXXIV, fig. 3). In the second foot two of these project beyond the tip of the foot, and the dorsal cirrus is longer, its tip reaching beyond that of the foot. The terminal papilla is also longer. This foot is smaller than the first.

The third foot is shorter, but is likewise directed forward and outward, and it differs from the foregoing in the longer dorsal cirrus, and in the short lobate condition of the ventral cirrus, which is thus homologous with the ventral pads which occur at the bases of the feet behind. The foot is considerably diminished in size, the dorsal cirrus is very long, and the distal papilla extends far beyond the tip. Dorsally the setigerous lobe bears simple and brush-shaped bristles, and below these the tenth foot has dorsally the subulate dorsal cirrus, from the inner base of which the first branchia arises as a somewhat broad crenate process which varies in length according to the example; some having short processes, others having a branchia about as long as the dorsal cirrus and occasionally a spur appears on it toward the tapering distal end. The setigerous region is bluntly conical with a stout papilla projecting in front of the bristles anteriorly, whilst posteriorly is a longer subulate process or papilla resembling a cirrus. The ventral cirrus is in the form of a pad inferiorly. Dorsally and ventrally are stout bristles with rather short and finely tapered tips which have broad wings inferiorly. A few brush-shaped forms are also present, and a single long hook with a bifid tip.

The branchiæ thus commencing on the tenth foot continue as single filaments almost to the tip of the tail. Whilst these organs form long thick processes, the dorsal cirri diminish in size from before backward, the disproportion between the posterior branchiæ and their minute cirri being great, the dorsal cirrus, moreover, moving further up the branchia in each case.

The twentieth foot (Plate LXXV, fig. 5) presents dorsally the large branchia which has absorbed the whole basal region, so that the small, slender cirrus appears as a process of the branchia. The setigerous region forms a short cone with a bulbous tip. The bristles are the same as in front, viz., dorsally and ventrally stout simple bristles (Plate LXXXIV, fig. 3 *a*) with a broad wing on the short and finely tapered tip, a few brush-like forms (Plate LXXXIV, fig. 3 *b*), and the powerful bifid hooks with wings (Plate LXXXIV, fig. 3 *c*).

The structure of the foot alters little posteriorly except in the proportion of its parts. The brush-shaped bristles are often prominent from the absence of the tips of the winged forms.

The tubes (Plate LXIII, figs. 7 *c* and 7 *d*) are formed of the tough translucent secretion of the glands, strengthened by pieces of shell, or sometimes attached to an entire valve of *Pecten*. Special attention has been paid to the nature of the protective internal valves of this species by Mr. Arnold Watson[1] (his *Onuphis conchilega*), and he figures two arrow-like valves at one end, but whether anterior or posterior is uncertain. The species appears to carry about its tube caterpillar-fashion (Watson). In the Zetlandic examples such bivalves as *Nucula*, *Leda*, and *Lucina* are frequent.

This species has certain resemblances to the *Diopatra socialis* of Ehlers (1875) from the 'Porcupine' Expedition of 1869, but, amongst other features, it diverges in the position of the tentacular cirri; the simple nature of the branchiæ throughout, whereas in *D. socialis* they are simple, bifid, or trifid; by the fact that they arise on the tenth segment; and in the nature of the tube, which in *D. socialis* is secretion and mud.

The relationship of *Nothria conchyphila* of Verrill (1885) remains uncertain, but it "constructs flat free tubes, about 2 ins. long, out of broken bivalves, and often occurs in vast numbers in the warm zone," viz., off the northern coast of the United States. The critical points are unfortunately not shown in the figures; indeed, the *Hyalinœcia artifex* of this author likewise closely approaches the British form.

2. Onuphis brevibrachiata, *Ehlers*, 1875. Plate LXIII, figs. 8 and 8 *a*—teeth; figs. 10 and 10 *a*—head; Plate LXXV, figs. 6 and 6 *a*—feet; Plate LXXXIV, figs. 4–4 *c*—bristles.

Specific Characters.—Head with two rounded and flattened frontal tentacles. Tentacles short, arising from a ringed cirrophore. Tentacular cirri slightly fusiform from a constriction at the base. Palpi form two flattened bosses ventrally. Body resembling that in *Hyalinœcia*. Dental apparatus has strongly curved maxillæ, which are sharp at the point and rather abruptly swollen a little behind the middle. The posterior appendages are half-spoon-shaped, with a constriction at the base. Great dental plates have about ten teeth, and the azygos plate has the same number. Right anterior curved plate has five teeth; left broken, but appears to have more. Mandibles with an oblique smooth edge anteriorly, and an external projection. Branchiæ commence on the twelfth foot, are simple as far as the sixteenth foot, the seventeenth having a branched branchial process, the twentieth a simple base attached to the cirrus, and the rest being dichotomously divided. The thirtieth branchia has three divisions, and then the tip is dichotomously divided. First three feet much larger than the succeeding, more or less ventral in position, flattened and directed outward. Ventral cirrus of the first shifted, so that it adjoins the mouth. The tenth foot has a subulate dorsal cirrus with a ventral hiatus followed by a swelling from which it tapers to the point. It is supported by slender spines, the blunt points piercing the tip, and a short flap projects posteriorly. Dorsal bristles long, translucent, slightly curved, and finely tapered—with narrow serrated wings. Ventral bristles translucent, shafts enlarged and bevelled distally for articulation with the long tapering terminal piece. The latter kind of bristles disappear at the twentieth foot,

[1] 'Trans. Liverp. Biol. Soc.,' vol. xvii, p. 311, pl., fig. 8.

their places being taken by two powerful yellowish hooks with bifid, winged tips. The brush-shaped bristles offer no peculiarity.

Synonyms.

1875. *Diopatra brevibrachiata,* Ehlers. Zeitschr. f. wiss. Zool., Bd. xxv, pp. 21 and 49, Taf. iii, figs. 11—21.

1903. *Onuphis* (*Diopatra*) *brevibrachiata,* McIntosh. Ann. Nat. Hist., ser. 7, vol. xii, p. 133, pl. x, figs. 5—10.

Habitat.—Dredged in the 'Porcupine' Expedition of 1869 at Station 36, 21st June, 48° 50′ N., 11° 7′ W., and therefore in the British area, at a depth of 725 fathoms on a bottom of sandy mud.

Also procured in the 'Porcupine' Expedition of 1870, probably between Stations 46 and 47, in 358 fathoms, and east of Cape de Gatte, six miles from shore, in 60 to 160 fathoms, and west of the Strait of Gibraltar, on a bottom of fine grey mud, and in water varying from 286 to 322 fathoms in depth.

Head (Plate LXIII, figs. 10 and 10 *a* [after Ehlers]) with two frontal tentacles (Stummelfühler) arising close together in the median line, and forming two rounded and somewhat flattened lamellæ in spirit. The five tentacles have the normal position, but they are short—much shorter than in *Diopatra neapolitana*—though they also have an enlarged, ringed cirrophore. The tentacular cirri arise from the anterior border of the first segment, are wide apart, and have a slightly fusiform outline due to a constriction at the base. The palpi form two flattened bosses on the ventral surface.

Body somewhat resembling that in *Hyalinœcia*, but readily distinguished by the presence of the tentacular cirri and the condition of the branchiæ, which lean to the type seen in *Eunice*. The length is uncertain, as no complete example occurs. Ehlers gives 24 mm. and forty-four segments, with a breadth 3–4 mm. The first segment of the body is about the breadth of the succeeding. The dental apparatus (Plate LXIII, fig. 8) is pale, a dark brown touch occurring at the tip of the posterior appendages of the maxillæ, whilst at the junction of the several parts is a triradiate band. The tips of the maxillæ and the teeth of the great dental plates are slightly brownish. The maxillæ are strongly curved, sharp-pointed, and rather abruptly swollen a little behind the middle. The posterior appendages are half-spoon-shaped, with a constriction at the base. Each of the great dental plates has about ten teeth, and the azygos plate the same number. The right anterior curved plate has five; the left appears to have a larger number, but is broken. The mandibles (Plate LXIII, fig. 8 *a*) have an oblique smooth edge anteriorly, and at the junction of this with the shaft, externally, is a projection.

The branchiæ commence on the twelfth foot as simple filaments attached to the dorsal cirrus a little above its base. As far as the sixteenth foot they remain simple, long filaments. The seventeenth foot has a branched branchial process, and at the twentieth it has a single stalk above the cirrus, and the terminal part is dichotomously divided—a feature of the species. At the thirtieth foot three divisions occur above the cirrus, which they considerably exceed in length, and then the tip is dichotomously divided into two still longer processes. The specimen terminated at the thirty-fifth foot, and on this, so far as could be seen in the injured preparation, the number of gill-filaments was not less.

The first three feet are much larger than the succeeding, flattened laterally and directed outward. The first foot has a large and rather thick dorsal cirrus, which is bent downward, whilst into its base pass three spines. A bluntly conical setigerous region follows, having a short tapering papilla at the tip. No bristles are present. The ventral cirrus is of considerable size, somewhat fusiform in outline, and shifted so that it adjoins the mouth. The next two feet (second and third) are similar in general structure, the size slightly increasing, and the ventral cirrus of the third foot is both larger and more flattened. In none do bristles project beyond the skin, though they occur internally below the spines. The fourth foot, like the foregoing, is more or less ventral in position. Its dorsal cirrus is large and subulate, the setigerous region has short bristles projecting from its edge, and the ventral cirrus is a lanceolate or conical lobe immediately beneath it.

At the fifth foot conspicuous glistening bristles project from the setigerous region, which has a posterior flap. The dorsal cirrus is somewhat less, though still prominent, and the ventral cirrus is visible inferiorly as a short process. The dorsal bristles are translucent and finely tapered, with narrow wings and serrated edges, as in the feet behind. The ventral are equally translucent, and have their shafts slightly curved and dilated at the bevelled end, from which a long tapering blade extends distally. The ventral cirrus is by-and-by included in the low glandular pad (behind the foregoing region), and the dorsal cirri diminish in size.

The tenth foot (Plate LXXV, fig. 6) has a subulate dorsal cirrus with a ventral "bite," followed by a swelling, from which it tapers to the point. It is supported by a group of slender spines. The setigerous region has two strong spines, the blunt points of which pierce the tissues, and a short flap projects posteriorly. Superiorly is a group of long, translucent, very slightly curved, finely tapered bristles (Plate LXXXIV, fig. 4) with narrow wings, which are serrated at the edge. The ventral bristles (Plate LXXXIV, fig. 4 *a*) are equally translucent, and have slightly curved shafts—enlarged and bevelled at the ends for articulation with the long tapering terminal piece, which at the base is fully the breadth of the enlarged end of the shaft.

At the twentieth foot the jointed bristles have disappeared, and their places are taken by two powerful yellowish hooks with bifid winged tips (Plate LXXXIV, fig. 4 *b*), which in outline resemble miniature pliers. The dorsal bristles have shorter tips with a more distinct bend at the end of the shaft. The two brown spines have increased in strength. The thirtieth foot (Plate LXXV, fig. 6 *a*) presents little change on the foregoing, except in the branchiæ and the slightly increased slenderness of the dorsal bristles. The brush-shaped bristles (Plate LXXXIV, fig. 4 *c*) offer little peculiarity. From the posterior end of the fragment projected a series of fibres, apparently formed by the glands of the annelid, and enveloped in a translucent matrix. The secretion is probably allied to that of *Panthalis*. The example from Cape de Gatte had the same tough fibres projecting from its broken end, and *Loxosomæ* occurred on many of the branchial processes.

This species approaches the *Diopatra brevibrachiata* of Ehlers, though no spiral line appeared on any branchiæ present. Ehlers states that the first segment is broader than the succeeding, but in this form little difference between them is observed. The number of teeth in the dental plates is greater. It differs from *Diopatra simplex*, Grube (=*Onuphis Panceri*, Claparède), in the form of the anterior feet and other particulars.

3. Onuphis conchylega, *Sars*, 1835. Plate LXIII, fig. 9 in tube; Plate LXIV, figs. 1, 1 *a* —teeth; Plate LXXV, fig. 7—foot; Plate LXXXIV, figs. 5–5 *c*—bristles.

Specific Characters.—Head resembling that of *Onuphis britannica*, but differing in the shorter and more rounded frontal tentacles with pigment behind them. The eyes are somewhat less. Tentacles with ringed cirrophores (in spirit). The first segment is narrow, and carries the tentacular cirri at its anterior border. The proboscis agrees in colour with that of *Onuphis britannica*, the T-shaped dark bands being conspicuous at the posterior appendages, as well as a dark patch at the posterior end of each great dental plate. An incurvation of the inner edge of each maxilla occurs, connected by the dark mass of pigment with the great dental plate. Right great dental plate has nine teeth; the left eight; the azygos plate has nine or ten teeth. The left anterior curved plate has nine or ten teeth; the right has twelve. The usual dark brown base occurs at each of the latter. A single isolated denticle lies outside each. The mandibles have an oblique anterior edge with a single denticle, and long tapering shafts. First pair of feet somewhat shorter than in *Onuphis britannica*, and the terminal flap is nearly circular, the dorsal cirrus is subulate, the posterior papilla nearly cylindrical, and the ventral cirrus (on each side of the mouth) has a slight constriction in the middle. The stout falcate bristles are strongly hooked at the tip, and beneath is a small secondary process or ridge. The tenth foot has a long subulate dorsal cirrus, a minute button-like anterior papilla, and a long posterior papilla at the tip. The ventral cirrus forms a boss. Dorsally are stout simple bristles, with the tip bent at an angle, and winged as well as finely tapered. A single bifid hook beneath. The branchiæ in some begin on the eleventh, though generally on the twelfth foot, and each continues as a simple filament almost to the tip of the tail. Marenzeller[1] describes in the examples from Spitzbergen two or more divisions, but they never exceed four, the northern forms thus differing from the southern in this respect.

Synonyms.

1835. *Onuphis conchylega*, Sars. Beskr. og Iaktt., p. 61, Tab. x, f. 28*a*—*e*.
„ *Diopatra Eschrichti*, Grube. Fam. Annel., pp. 43 and 123.
1843. *Onuphis Eschrichtii*, Œrsted. Grönl. Annul. Dors., p. 20, Tab. iii, f. 33—41, 45.
1851. „ *conchylega*, Sars. Nyt Mag. f. Naturvid., vi, p. 209.
„ „ „ Grube. Fam. Annel., pp. 44 and 123.
1853. „ „ Sars. Nyt Mag. f. Naturvid., vii, pp. 386 and 391.
„ „ *Eschrichtii*, Stimpson. Invert. Gr. Manan, p. 33.
1857. „ „ Danielssen. Reise, p. 59.
1858. „ „ idem. Ibid., p. 116.
1859. „ *conchylega*, Sars. Ibid., p. 14 (sep. copy).
1860. „ „ Packard. Canad. Nat. and Geol., vol. vii, p. 403.
1863. „ *conchilega*, Stimpson. Ann. Greenl. in Proc. Nat. Sc. Philad., p. 140.
1865. *Diopatra Eschrichtii*, De Quatrefages. Annel., i, p. 349.
„ *Nothria conchylega*, Johnston. Cat. Worms Brit. Mus., pp. 138 and 341.

[1] 'Archiv f. Naturges.,' lv, p. 129, 1889.

1866–69. *Onuphis Eschrichtii,* Packard. Mem. Bost. Soc. Nat. Hist., i, p. 294.
1867. *Nothria conchylega,* Malmgren. Annul. Polych., p. 66.
1873. „ „ M. Sars. Bidrag Christ. Fauna, iii, p. 16 (sep. copy).
1874. „ „ Malm. Göteb. vet. o. vitt. Handl., xiv, p. 85.
„ „ „ Smith and Harger. Trans. Conn. Acad., iii, pp. 11, 16, 20.
1875. „ „ Möbius. Jahresb. Comm. deutsch. Meere, p. 168.
1876. „ „ McIntosh. Proc. Roy. Soc., xxv, p. 217.
1878. *Onuphis Eschrichti,* Grube. Schlesisch. Gesellsch., 20th June, 1877 (sep. abdr.), p. 11.
„ *Nothria conchylega,* Marenzeller. Denksch. k. Akad. Wien., Bd. xxxv, p. 396.
„ *Onuphis* „ McIntosh. Trans. Linn. Soc., Zool., i, p. 503.
1879. „ „ Hansen. Nyt Mag. f. Naturvid., xxiv, p. 268.
„ „ *hyperborea,* idem. Ibid., p. 5, Tab. iv, f. 1—9.
„ „ *conchylega,* Théel. K. Sv. Akad. Handl., Bd. 16, No. 3, p. 44.
„ *Nothria* „ Tauber. Annul. Danic., p. 102.
1881. *Onuphis* „ Horst. Niederl. Arch. Zool., Suppl. Bd. i, p. 14.
1882. „ *hyperborea,* Hansen. Norsk. Nord.-Exped., vii, p. 32, pl. iv, f. 5—13.
1883. „ *conchylega,* Wirén. Chætop. 'Vega' Exped., p. 403.
„ „ „ Levinsen. Vidensk. Meddel. Foren. Kjöben., p. 226.
„ „ *hyperborea,* idem. Ibid.
1885. *Nothria conchylega,* McIntosh. 'Challenger' Annel., p. 305.
1889. *Diopatra* „ Marenzeller. Arch. f. Naturges., lv, p. 129.
1891. *Onuphis conchilega,* Hornel. Trans. Biol. Soc. Liverp., vol. v, p. 240.
1893. *Nothria conchylega,* Levinsen. Vidensk. Ud. "Hauchs," p. 331.
1901. „ „ Whiteaves. Geol. Surv. Canada, No. 722, p. 79.
1903. *Onuphis* „ McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 555.
„ „ „ idem. Ibid., vol. xxii, pp. 149 and 164.
1906. „ *eschrichtii,* Augener. Bull. Mus. Comp. Zool., vol. xliii, p. 141.
1908. *Diopatra conchylega,* Ehlers. Deutsch. Tiefsee Exped., p. 79.
1909. *Nothria* „ Moore. Proc. U.S. Nation. Mus., vol. 37, p. 138.

Habitat.—In vast numbers in 608 fathoms in the Atlantic as dredged by H.M. ship 'Triton,' Station 9, 23rd August, 1882; off Tynemouth in forty fathoms (Prof. G. S. Brady). Frequently procured in the deeper parts of the North Sea by the Fishery Board Ship "Goldseeker."

Ranges to the Norwegian shores, to Greenland, Finmark (Canon Norman, Œrsted, McIntosh), Nova Zembla (Théel), and the American coast. Numerous examples from depths ranging from 98 to 325 fathoms off Florida (Ehlers), Eastern shores of America (Verrill).

Head (Plate LXIII, fig. 9) generally resembling that of *Onuphis britannica*, but differing in the shorter and more rounded frontal tentacles, which likewise have pigment behind them. The eyes are somewhat less and lie to the exterior of the bases of the long or posterior lateral tentacles. The palpi are similar. The tentacles have ringed cirrophores in the preparations.

Body (Plate LXIII, fig. 9) of the same general outline as in *O. britannica*. The first or peristomial segment is narrow and bears the tentacular cirri[1] towards its anterior border—one on each side dorsally. They are somewhat short. The proboscis and its

[1] Grube states that *O. conchylega* has no tentacular cirri.

armature (Plate LXIV, fig. 1) resemble in colour and general aspect that of *Onuphis britannica*. The T-shaped dark bands are conspicuous at the posterior appendages, and a dark patch occurs at the posterior end of each great dental plate. The aspect and curvature of the maxillæ are the same. A little in front of the posterior appendages an incurvation of the inner edge of each occurs, connected by the dark mass with the base of the great dental plate. The right great dental plate has nine teeth and a posterior ridge; the left has eight and a ridge. The azygos plate (left) has nine or ten teeth. The curved anterior plate on the left has nine or ten teeth; that on the right has about twelve. Each of these plates has a dark brown base. A single isolated denticle occurs beyond (anterior to) each curved process. The mandibles (Plate LXIV, fig. 1 *a*) have a single denticle on the oblique edge in front and long tapering shafts. The outer edge is pointed. The segment following the peristomial is about the same breadth and carries the first pair of feet, which are shorter than in *O. britannica*, have a nearly circular flap at the tip, though this varies in different specimens, and a little within it arises the subulate dorsal cirrus. Posteriorly is a blunt and nearly cylindrical papilla, and ventrally, on each side of the under lip, is a short, thick ventral cirrus with a slight constriction at the middle, as if a cirrophoral differentiation existed. The foot forms a short cone supported by three tapering spines, and with a series of long and strong falcate bristles (Plate LXXXIV, fig. 5), the tip of which is boldly hooked, with a small secondary process or ridge a short distance beneath. From the edge of the hook below the ridge, wings extend forward to the tip. In the developing hook the part first formed is the tip, and it is then seen that the secondary process attains no larger size than what is figured and described (Plate LXXXIV, fig. 5 *a*). In many examples, however, the tip forms a rounded blunt hook without a trace, or only with a very slight trace of the secondary process, and devoid of wings, a condition probably due to attrition. The tip as a rule remains boldly hooked. The structure of the foregoing bristle or hook is fundamentally different from that of *Onuphis britannica*.

The second foot forms a still shorter conical process, also usually directed forward, and having a rounded flap projecting from the tip. The dorsal cirrus is subulate, considerably longer than in the first foot, and arises from the middle of the dorsum. The papilla from the posterior edge of the tip of the foot is long and subulate. The ventral cirrus has nearly the same form and size as in the first foot, the constriction indicating the ceratophore being clearly marked. Dorsally are short simple bristles which have only a trace of wings, and brush-shaped forms, the long and stout hooks beneath being the conspicuous appendages. Each hook has the structure already described, the tips of those projecting being blunt from wear. The third foot has still further diminished, though the dorsal cirrus is longer. The terminal button-like flap is smaller, the posterior papilla is long, but the ventral cirrus is a short ovate lobe attached to the base of the foot ventrally. The bristles and hooks are the same.

The tenth foot has a long subulate dorsal cirrus arising from the base (Plate LXXV, fig. 7), a short conical setigerous region, with a minute button-like papilla at the tip, and a long posterior papilla. The ventral cirrus now forms a rounded boss which is becoming less and less prominent. The setigerous region has stout simple bristles with the tip bent

at an angle and winged, as well as finely tapered (Plate LXXXIV, fig. 5 *b*). Brush-shaped bristles occur amongst them. A single bifid hook (Plate LXXXIV, fig. 5 *c*) is present.

A trace of a branchial process appears in some on the eleventh foot, but as a rule only on the twelfth foot. It is continued backward, as in the former species, almost to the tip of the tail. It is a simple process throughout; only occasionally is an accessory filament found on it. On the whole it is a considerably smaller process than in *Onuphis britannica*. The dorsal cirrus diminishes from before backward.

The tube (Plate LXIII, fig. 9) generally consists of coarse gravel and minute stones fixed to a lining of the secretion. More rarely it is formed of fragments of shells and stones. Dr. Johnston found the glairy secretion so tenacious that the threads could be drawn out a foot without breaking.

Several forms, though differing in certain features, approach this species, such as *Onuphis abranchiata*, *O. pycnobranchiata*, and *O. macrobranchiata* of the 'Challenger.'

Hansen (1879) gave a description of this form as a new species in the account of the Annelids of the Norwegian North Atlantic Expedition in 1876, and mentioned it subsequently in the next year's Expedition. His figures are somewhat indefinite in detail, but, like the description, give no new feature.

Horst's figure[1] of the jaws of the species is good, though his example has asymmetrical posterior processes to the maxillæ.

Ehlers (1887), in his 'Florida Anneliden,' adopts Œrsted's title under the genus *Diopatra* as *D. Eschrichtii*, yet admits that it is identical with the *Onuphis conchylega* of Sars.

Hornel (1891) mentions this species as common off the Liverpool bar, but whether his form pertains to *O. britannica* or *O. conchylega* is uncertain, though in all probability it is the former.

The *Nothria opalina* of Verrill[2] is probably a closely allied form, if not one of the foregoing species.

4. Onuphis quadricuspis, *M. Sars*, 1871. Plate LXIV, figs. 2 and 2 *a*—teeth; Plate LXXV, fig. 8—foot.

Specific Characters.—*Head* nearly typical, but the median is considerably shorter and somewhat more slender than the adjoining tentacles. Frontal processes (antennæ, Sars; palpi, Ehlers) ovate, small. No eyes. Tentacular cirri two, at the anterior border of the buccal segment. Body elongate, minute, pale bluish iridescent, with two adjacent brownish bands in the mid-dorsal region. Segments about 150 (Sars), flattened, with the exception of the first five. It is little tapered anteriorly, but more distinctly so posteriorly, where it ends in four cirri—two longer dorsal and two shorter ventral. Branchiæ begin as simple processes on the ninth foot, by-and-by become bifid, then in three to five divisions or pectinate, and finally in the posterior part of the body again simple (Sars). Proboscis with the maxillæ much curved with a marked constriction behind the point of junction,

[1] 'Niederl. Arch. Zool.,' Suppl. Bd. i, 1881.

[2] 'Proc. Amer. Assoc. Sc.,' 1873, p. 381, pl. 4, f. 4, 1874.

where a bar of pigment occurs. The posterior processes are pointed. Left great dental plate has six teeth; the right has eight. The left lateral paired plate has six, the unpaired six. The right lateral has seven teeth. The mandibles have curved shafts and the cutting edge a denticulation or two, somewhat symmetrically arranged. Tube smooth, a delicate hyaline secretion coated with greyish sticky mud or muddy sand.

Synonyms.

1871. *Onuphis quadricuspis*, M. Sars. Vidensk.-Selsk. Forhandl., 1871, p. 4 (sep. copy).
1873. „ „ G. O. Sars. Bidrag K. Christ. Fauna, p. 16, Tab. xv, f. 7—19.
1875. *Diopatra socialis*, Ehlers. Zeitschr. f. wiss. Zool., Bd. xxv, p. 46, Taf. iii, f. 5—10.
„ „ *quadricuspis*, Möbius. Jahresb. Comm. deutsch. Meere, p. 168.
1878. *Onuphis* „ Grube. Schles. Gesellsch., Breslau, 1878 (sep. abdr.), p. 10.
1879. *Diopatra* „ Tauber. Annul. Danic., p. 103.
„ „ „ Hansen. Nyt Mag. f. Naturvid., xxiv, p. 268.
1885. *Nothria* „ McIntosh. 'Challenger' Annel., p. 332.
1903. *Onuphis* „ idem. Ann. Nat. Hist., ser. 7, vol. xii, p. 149.

Habitat.—Dredged at various stations during the 'Porcupine' Expedition of 1869, viz., Station VI, 808 fathoms, Station VII, 725 fathoms, and Station VIII, 650 fathoms, on a bottom of muddy sand or sticky mud (Ehlers). Dredged by the 'Knight Errant' at Station VI, August 11, 1880, lat. 59° 37′ N., long. 7° 19′ W., in 530 fathoms; bottom temperature 46°·5, surface temperature 57°·0; sea-bottom ooze.

Norway, Dröbach (M. Sars). Extends to Canada (Dr. Whiteaves).

Head[1] more or less typical, but the median is considerably shorter than the adjoining tentacles, all of which have a ringed cirrophore— often of considerable length.

Body minute, about 1 mm. in diameter, but apparently typical in structure. The buccal segment is broad and bears the subulate tentacular cirri.

The maxillæ (Plate LXIV, fig. 2) are much curved, and there is a marked constriction of the posterior processes immediately behind the point of junction. The processes are pointed posteriorly, and the tip of each is dark brown and a bar of pigment also exists behind the maxillæ. The left great dental plate has six teeth (seven, Ehlers), the right eight. The left lateral paired plate has six (four, Ehlers), the unpaired six (seven, Ehlers). The right lateral has seven. The mandibles (Plate LXIV, fig. 2 *a*) have curved shafts, and the cutting edge presents a denticulation or two, somewhat symmetrically arranged. The entire apparatus is soft. The dentition was not minutely examined by Sars.

The branchiæ begin as simple processes on the ninth foot (Plate LXXV, fig. 8), in which, as in other respects, it agrees with a specimen dredged by Canon Norman off Bergen, Norway, and with the descriptions and figures of M. Sars, as given from his unpublished manuscripts by G. O. Sars, and also of E. Grube. The specimen appears to be young, and has only about twenty-five segments. The branchiæ, therefore, have not attained full development. The highest number of divisions is four, as Prof. Grube also states, whereas five are present in the Norwegian form. Ehlers, again, indicates considerable variation in the origin of the branchiæ in the example (his *Diopatra socialis*) from

[1] From the description in the 'Challenger' volume.

deep water, one having these on every foot, whilst in others they range from the sixth to the eighth backward.

The first foot has dorsal and ventral cirri and a rather longer and larger median process behind the setigerous lobe. A few slender spines go to the base of the dorsal cirrus, whilst the setigerous lobe bears a tuft of rather strong bristles with slender, minutely-hooked tips, probably bifid, but the preparation is indistinct on this head. The wings are prolonged to a filamentous process at the tip, and occasionally they separate.

At the tenth foot simple winged bristles occur, and two stout bifid hooks (Plate LXXV, fig. 8, ninth foot), the shaft being enlarged in the middle and convex forward, then sloping gently backward to the neck. The main fang is very strong, its inferior edge forming more than a right angle with the shaft, and a strong tooth curved slightly forward projects from the crown. The twentieth foot presents similar bristles and hooks, and, in addition, three spines of varying size, but with the tips prolonged as filiform processes. The brush-shaped bristles of the upper division offer no peculiarity.

The posterior feet agree for the most part with the last-mentioned, each having three spines with the filiform tips, two long hooks, and a tuft of bristles with narrow wings.

The tube is composed internally of a delicate hyaline secretion coated either with sticky mud or greyish muddy sand, and it is rather friable.

This is one of the many discoveries made by M. Sars (1871) in the Norwegian waters, and described from his manuscripts after his death by his talented son. It apparently haunts the deeper waters up to 300 fathoms off Lofoten, and to a greater depth off the British shores.

5. Onuphis fragosa, *Ehlers*, 1887. Plate LXIV, figs. 3–3 *b*—head, teeth, tube; Plate LXXV, figs. 9 and 9 *a*—feet; Plate LXXXIV, figs. 6–6 *b*—bristles.

Specific Characters.—Head comparatively small, with slender tentacles of moderate length, the median being shorter than the adjoining lateral, and all the posterior tentacles having long, ringed cirrophores. The anterior form rounded bosses. Body somewhat rounded in front, flattened throughout the rest of its extent. First segment narrower than the succeeding, and carries the comparatively short, subulate tentacular cirri at its anterior border. Proboscis, yellowish with dark touches. Maxillæ strongly curved anteriorly and acute. A dark band between them and the posterior appendages, which are spathulate, with a notch at the end. Right great dental plate has nine teeth; left has nine. Azygos plate nine. The left anterior curved plate has eight, the right nine or ten. The mandibles are small in front with narrow tips in the centre, then a band of pigment, and laterally the sloped petaloid blade. First foot bears a series of translucent bristles with pseudo-articulations at the tips, which are minutely bifid and furnished with long pointed wings. A few simple bristles with tapering tips (without evident wings) occur dorsally. The feet decrease in prominence from the first to the fifth, and thereafter they still further diminish. The dorsal cirrus after the first six or seven becomes very

small, forming at the tenth foot a short subulate process. Besides the spines only short simple bristles, with tapering winged tips, are present. The dorsal bristles are more elongate at the twentieth foot, and beneath are two strong bifid hooks. Tube of greyish sticky mud. Branchiæ absent. Tube either of pure secretion like a quill or secretion strengthened with gravel and shell-sand.

Synonyms.

1887. *Diopatra* (*Paradiopatra*) *fragosa*, Ehlers. Florida Annel., p. 75, Taf. xx, f. 7—14; Taf. xxi, f. 1—4.
1903. *Onuphis* ,, ,, McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 556.

Dredged in 370 fathoms in the 'Porcupine' Expedition of 1869 in sticky mud off the coast of Ireland.

Norway (A. M. Norman); off the coast of Florida (Ehlers).

Head (Plate LXIV, fig. 3) comparatively small, with slender tentacles of moderate length, the median being shorter than the adjoining lateral, whilst the shorter anterior lateral have finely tapered tips. No eyes are visible in the preparations. The frontal tentacles are ovoid with narrow pedicles. The palpi form prominent rounded lobes on the ventral surface. All the tentacles have long ringed cirrophores.

Body somewhat rounded in front, flattened throughout the rest of its extent. The first segment has less breadth than the succeeding, and carries laterally, at the anterior border, the tentacular cirri, which are subulate and comparatively short. The general colour of the proboscis (Plate LXIV, fig. 3 *a*) is yellowish, with dark touches here and there. The maxillæ are acute and strongly curved anteriorly. A dark band lies between them and the posterior appendages, which are outlined in blackish-brown, and spathulate, a median notch occurring posteriorly. The right great dental plate has nine teeth; the left has nine. The azygos plate on the left has nine. The left anterior curved plate has about eight; the right nine or ten. The mandibles are small, terminating in front in two rather narrow central tips with a band of dark brown pigment externally between them and the expanded and sloped external blade.

The first foot (Plate LXXV, fig. 9) is short and is directed slightly forward, the dorsal and ventral cirri and the terminal papilla being of moderate length. It bears ventrally a series of translucent bristles (Plate LXXXIV, fig. 6), the curved tips of which are minutely bifid, with long, pointed wings extending beyond, whilst at the junction of the tip with the shaft is a pseudo-articulation, as in allied forms, though this is not shown by Ehlers. Dorsally are a few simple tapering bristles (often only one) in which no wing is evident.

The feet diminish in prominence from the first to the fifth, and thereafter they still further decrease so that they are by no means conspicuous. So far as can be observed no branchial process is present, even the dorsal cirrus, after the first six or seven, becoming very small.

The tenth foot has a short flatly conical setigerous region, which has, besides the spines, only short bristles with tapering winged tips. The ventral cirrus is now adnate, forming a rounded swelling beneath. The dorsal cirrus is a short subulate process.

At the twentieth foot the dorsal cirrus is still the same. Behind the dorsal bristles is a minute flat papilla, the remnant of the longer process anteriorly. The translucent dorsal bristles are considerably longer with traces of wings at their finely tapered tips (Plate LXXXIV, fig. 6 *a*). Below are two strong bifid hooks (Plate LXXXIV, fig. 6 *b*), the inferior hook marking off the setigerous region from the long elevated ventral pad formed by the metamorphosed ventral cirrus.

The species secretes a thin but tough tube (Plate LXIV, fig. 3 *b*) which is coated with the greyish sticky mud amongst which it dwells.

This form approaches the *Diopatra* (*Paradiopatra*) *fragosa* of Ehlers in the absence of branchiæ, and in the aspect of the head, tentacles, and body. The armature of the proboscis is also similar. Ehlers[1] describes and figures the tube, however, as formed of fragments of shells set on edge after the manner of tubes of *Owenia filiformis*.

Genus LXIX.—Hyalinœcia, *Malmgren*, 1867.

Head with ovate frontal lobes, five smooth filiform tentacles arising from ringed cirrophores. Eyes two, or absent in the preparations. Palpi in the form of two bulbous pads, separated by a median fissure ventrally. No tentacular cirri. Body long, flattened, slightly tapered anteriorly, more distinctly tapered posteriorly, and ending in two long anal cirri, with the anus on the dorsum of the last segment (pygidium). Proboscis with maxillæ enlarged posteriorly, and all the parts well developed. Mandibles have long tapering shafts and leaf-like notched anterior edges. First foot is large and slopes forward, and has a disc-like process at the tip. It carries falcate bristles. Ventral cirrus soon becomes pad-like. Winged and brush-shaped bristles occur dorsally in the anterior feet, then strong bifid hooks appear below them with a few winged bristles inferiorly.

1. Hyalinœcia sicula, *De Quatrefages*, 1865. Plate LXIV, figs. 4–4 *c*—head, teeth, and tube; Plate LXXV, fig. 10—foot; Plate LXXXIV, figs. 7–7 *d*—bristles.

Specific Characters.—Head as in *Hyalinœcia tubicola*. The small black eyes lie outside the base of the long lateral tentacles. All the tentacles have ringed cirrophores. Body characterized in spirit by two parallel bands of brown from a transverse belt behind the head, and by a brown spot between each foot from the fifth backward. Maxillæ strongly curved and sharp-pointed; the posterior appendages elongated and conical. The right great dental plate has nine or ten teeth; the left has eight; the azygos plate has eight. The curved anterior plates seem to have few teeth—four or five on the right, fewer on the left. Mandibles with long, narrow, and tapering shafts, and a blunt, leaf-like anterior plate with a few notches. Branchiæ commence on the fifth foot, and extend as a simple process beyond the fiftieth foot. The bristles of the anterior feet (*e.g.*, the first) have the end of the shaft slightly dilated, and the bevelled region has spikes. The moderately elongated terminal piece is sloped at the base and bifid at the tip, the

[1] 'Florida Annel.,' p. 76, Taf. xxi, f. 4.

prominent processes being guarded by wings. The simple bristles have very narrow wings. The powerful posterior hooks somewhat resemble the bifid forms of *Eunice* and of other Onuphids. The tube is long and narrow, formed of an inner lining of secretion, more or less strengthened by minute particles of shells, fragments of echinoderms, and similar structures.

Synonyms.

1865. *Onuphis sicula,* De Quatrefages. Annel., p. 352.
1869. „ „ McIntosh. Rep. Brit. Assoc. (1868), p. 337.
„ *Hyalinœcia sicula,* idem. Trans. Roy. Soc. Edinb., vol. xxv, p. 418, pl. xvi, f. 3, 3*b*, 3*c*.
1870. „ *bilineata,* Baird. Journ. Linn. Soc., vol. x, p. 358.
1901. *Onuphis sicula,* Whiteaves. Geol. Surv. Canada, No. 722, p. 80.
1903. „ „ McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 557.

Habitat.—In ninety fathoms off North Unst, Shetland (J. G. Jeffreys); Plymouth (Allen); Coast of Cornwall (Baird); Connemara, Galway (A. G. Moore). 'Porcupine' Expedition of 1869, off the coast of Ireland in sticky mud at 370 fathoms; Nymph Bank, S.W. Ireland, in 52½ fathoms, Royal Irish Academy's Expedition, 1886. 'Porcupine' Expedition of 1870, at Station VIII, Lat. 48° 26′ N., Long. 9° 44′ W., in 358 fathoms and a bottom temperature of 50° F., and at various stations in the southern waters without and within the Mediterranean, generally on sand or muddy sand. Also obtained by the 'Knight Errant' at Station III.

Shores of Italy, Sicily, and Palermo (De Quatrefages). 'Porcupine' Expedition, 1870, east of Cape de Gatte, six miles from shore in 60—160 fathoms. Gulf of St. Lawrence (collected by Whiteaves).

Head (Plate LXIV, fig. 4) with three elongated tentacles—a median and two lateral as in *Hyalinœcia tubicola*. The small black eyes lie to the exterior of the base of the long lateral. All the tentacles have ringed bases, and in the preparations (spirit) they often present crenations or pseudo-articulations.

Body characterized in spirit by two parallel bands of brown which course along the iridescent dorsum from a transverse belt of the same colour immediately behind the head, and by a brown spot between each foot from the fifth backward.

Proboscis.—Maxillæ (Plate LXIV, fig. 4 *a*) strongly curved and sharp-pointed. The posterior appendages are elongated and conical. The right great dental plate has nine or ten teeth. The left great dental plate has eight teeth; the azygos plate has eight. The curved anterior plates seem to have few teeth, four or five on the right, fewer on the left, but they may have been broken. The mandibles (Plate LXIV, fig. 4 *b*) have long, narrow, slightly curved and tapering shafts, and a blunt leaf-like anterior region with a few notches. The branchiæ commence as a simple filament on the dorsal cirrus of the fifth foot, and appear to extend far backward (beyond the fiftieth foot), but both they and the cirrus are considerably diminished in size, the branchia, at first the smaller, becoming the larger and continuing so to the end of the fragments.

In the structure of the bristles of the anterior feet a marked difference distinguishes this species from *Hyalinœcia tubicola* and *O. conchylega*, since instead of the large unjointed winged hooks characteristic of these, jointed or compound forms, after the fashion

of those of *Eunice*, occur (Plate LXXXIV, figs. 7 and 7 *a*). The end of the shaft is slightly dilated and the bevelled region has spikes. The moderately elongated distal piece is sloped at the base and bifid at the tip, both the terminal and the secondary processes being prominent, and they are guarded by wings. The bristles (Plate LXXXIV, figs. 7 *b* and 7 *c*) are slender and have very narrow wings, whereas in the fully developed forms of the two species above mentioned they have the shape of Valentin's knife.

Posteriorly the jointed hooks are supplanted by two simple forms which resemble those so frequently found in *Eunice*, wings being present in the perfect examples, but they are sometimes abraded. The bristles are also shorter and some are characteristically curved at the point. None of the brush-shaped bristles were observed. The hooks in the posterior region (Plate LXXXIV, fig. 7 *d*) have a powerful main fang and a smaller one on the crown.

This species inhabits a tube (Plate LXIV, fig. 4 *c*) composed of secretion strengthened by gravel and shell-fragments, yet De Quatrefages thought that its tube resembled that of *Hyalinœcia tubicola*.

Ehlers (1868) confused this species with *Hyalinœcia tubicola*, from which it differs in essential features, such as the arrangement of the branchiæ, the presence of eyes, the structure of the bristles, and the pigment.

Dr. Baird (1870) described this form as new under the name of *Hyalinœcia bilineata*, his examples having been dredged off the coast of Cornwall. He noticed that it had a pellucid, soft tube of a thin horny texture, but he does not allude to any extraneous materials.

Grube (1878) considered De Quatrefage's species as identical with *Hyalinœcia tubicola*.

2. Hyalinœcia tubicola, *O. F. Müller*, 1788. Plate LIV, figs. 5, 5 *a*—head, and 5 *b*—teeth; Plate LXIV, figs. 5–5 *b*—head, teeth, tube; Plate LXV, fig. 15—mouth; Plate LXXV, fig. 11—foot; Plate LXXXIV, figs. 8–8 *d*—bristles.

Specific Characters.—Head typical, the tentacles arising from ringed bases, and being long and smooth. No eyes. The frontal lobes (palps, Pruvot; tentacles, Grube) are ovate. The palpi form two bulbous pads separated by a median furrow ventrally. Body long, of about eighty-five bristled segments, pale brownish, iridescent, with the double red line along the dorsum, and the bright red double line in each branchia. The first segment is narrower than the succeeding. The second segment is considerably broader and carries the first feet, which are large, slope forward, and have a disk-like process at the tip. No tentacular cirri. The falcate bristles are strongly hooked at the tip, and beneath is a prominent secondary process resembling that in *Onuphis britannica*, and winged. At the sixth and seventh feet the ventral cirrus is pad-like. Proboscis with maxillæ enlarged posteriorly so as to leave a short hooked anterior region. Posterior appendages bluntly conical in outline. A dark brown border between these runs forward to a transverse bar between them and the maxillæ. Right great dental plate with thirteen teeth; left with thirteen (sixteen, Ehlers). Left anterior curved plate with seven teeth; right with eight. Mandibles with a slightly denticulated edge anteriorly and long tapering shafts.

At the tenth foot is a proportionally longer fusiform dorsal cirrus. The setigerous region has dorsally one or two long and rather stout bristles with winged and tapering tips, besides a group of brush-shaped forms. Below is a series of similar winged bristles with broader wings and shorter tips. The branchiæ commence about the twenty-third or twenty-sixth foot as simple filaments, and continue almost to the posterior end (absent in the last seven, Langerhans).

At the thirtieth foot the dorsal cirrus has diminished to a slender subulate organ, the branchia being very much larger and longer. The short blunt setigerous region has dorsally a group of three longer winged bristles with rather short tips. Brush-like bristles occur amongst them. Below are two strong bifid hooks. Then follow a few bristles with shorter tips and broader wings. A ventral pad represents the cirrus. Posteriorly the body diminishes to a somewhat flattened tail, with the anus on the dorsum and two long finely tapered caudal cirri. The tube is firm, horny, and quill-like, devoid of extraneous structures. It tapers towards one end, and has apertures at both.

Synonyms.

1766. *Nereis tubicola,* O. F. Müller. Zool. Danic. Prod., p. 217, No. 2625.
1788. „ „ idem. Zool. Danica, i, p. 18, Tab. xviii, f. 1—6.
1806. „ „ Turton's Linnæus, iv, p. 87.
1820. *Leodice* „ Savigny. Syst. Annel., p. 52.
1827. *Nereis* „ Bruguière. Encycl. Méth., Vers, i, p. 134, Tab. lv, f. 7—12.
1828. *Nereidonta tubicola* (Néreitube), De Blainville. Art. Vers in Dict. Sc. Nat., t. lvii, p. 447.
„ *Spio filicornis,* Delle Chiaje. Mem., vol. iii, pp. 173, 176, Tav. xlv, f. 6, 7.
1833. *Nereis tubicola,* Aud. & Edw. Ann. Sc. nat., t. xxvii, p. 228.
1834. *Onuphis* „ idem. Annél., p. 154.
„ *Eunice* „ Fleming. Encycl. Brit., 7th ed., vii, p. 219.
1835. *Onuphis* „ Sars. Beskr. og Iaktt., p. 48.
1838. „ „ Grube. Zur Anat. Kiemenw., p. 45, Tab. ii, f. 10.
1840. *Nereis* „ idem. Actin. Echin., etc., p. 82.
1844. „ „ W. Thompson. Rep. Brit. Assoc., 1843, pt. 2, p. 76.
1844–5. *Onuphis tubicola,* Œrsted. Kroyer's Nat. Tids. (Dröbak), p. 405.
1845. *Nereis tubicola,* Johnston. Ann. Nat. Hist., xvi, p. 6, with figs.
„ „ „ Peach. Rep. Brit. Assoc., 1844, pt. 2, p. 64.
1847. „ „ idem. Ray. Soc. Rep. Zool., 1843–4, p. 508.
1851. *Onuphis* „ Grube. Fam. Annel., pp. 44 and 123.
1852. *Eunice* „ Landsborough. Excurs. Arran, p. 49.
1853. *Onuphis* „ Sars. Nyt Mag. f. Naturvid., vii, pp. 386 and 391.
1859. „ „ idem. Reise, p. 14 (sep.).
„ „ „ Danielssen. Ibid., 1858, p. 115.
1864. „ „ Grube. Insel Lussin, p. 79.
1865. *Northia* „ Johnston. Cat. Worms Brit. Mus., pp. 136 and 341.
„ *Onuphis tubicola,* De Quatrefages. Annel., i, p. 351.
1867. *Hyalinœcia tubicola,* Malmgren. Annul. Polych., p. 67.
„ *Northia tubicola,* Parfitt. Trans. Devon Assoc., ii, p. 20 (sep. copy).
1868. *Onuphis* „ Ehlers. Borstenw., ii, p. 297, Taf. xiii, f. 1—14.
1869. *Hyalinœcia tubicola,* Baird. Journ. Linn. Soc., x, p. 357.
1873. „ „ K. Kupffer. Jahresb. Comm. deutsch. Meere, 1871, p. 150.

1873. *Hyalinœcia tubicola,* Sars. Bidrag Christ. Fauna, p. 16.
1874. „ „ McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 200.
„ „ „ Malm. Göteb. vet. o. vitt. Handl., xiv, p. 85.
1875. *Onuphis tubicola,* Möbius. Jahresb. Comm. deutsch. Meere, p. 168.
„ *Hyalinœcia tubicola,* McIntosh. Invert. and Fishes St. Andrews, p. 123.
„ *Onuphis* „ Marion and Bobretzky. Ann. Sc. nat., 6e sér., t. ii, p. 10.
1879. *Hyalinœcia tubicola,* Tauber. Annul. Danic., p. 103.
„ „ „ Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxiii, p. 291, pl. xv, f. 26.
„ „ „ Marion. Ann. Sc. nat., 6e sér., viii, Art. 7, p. 17.
1880. „ *artifex,* Verrill. Proc. U. S. Nat. Mus., iii, p. 357 (fide Augener).
1882. „ *tubicola,* Schmiedeberg. Mitth. Zool. Stat. Neap., t. iii, p. 373.
1883. „ „ Wirén. Chætop. Vega Exped., p. 403.
„ „ „ Levinsen. Vidensk. Meddel. Foren. Kjöbenh., p. 227.
1885. „ „ McIntosh. 'Challenger' Annel., p. 335.
„ „ „ Carus. Fauna Medit., i, p. 209.
„ „ „ Pruvot. Arch. Zool. expér., 2e sér., t. iii, p. 256, pl. xiii, f. 1—5.
1887. *Onuphis gracilis,* Ehlers. Florida Annel., p. 78.
1893. „ „ Levinsen. Vidensk. Ud. "Hauchs," p. 331.
„ „ „ Marenzeller. Zool. Ergebn., ii, p. 9.
1896. „ „ Roule. Camp. 'Caudan,' p. 445.
1898. *Hyalinœcia tubicola,* De St. Joseph. Ann. Sc. nat., 8e sér., t. v, p. 241.
1903. „ „ McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 557.
„ „ „ idem. Ibid., vol. xii, p. 164.
1904. „ „ Moore. Proc. Acad. Nat. Sc. Philad., vol. x, p. 144.
1906. „ „ De St. Joseph. Ann. Sc. nat., 9e sér., t. iii, p. 199, pl. iv, f. 75.
„ „ „ Augener. Bull. Mus. Comp. Zool., xlviii, p. 135.
„ „ „ Eisig. Fauna u. Fl. Neap., xxviii, p. 215.
1908. *Onuphis tubicola,* Ehlers. Deutsch. Tiefsee Exped., p. 83.
1909. „ „ Benham. Polych. Subantarctic Is., N. Zealand, p. 245.

Habitat.—In various parts of the deeper waters of the British seas, as off Plymouth. Off the Hebrides, Dr. J. G. Jeffreys, July, 1866. Off Balta, Shetland, in fifty fathoms, Dr. J. G. Jeffreys, 1867 (July). Ninety to one hundred fathoms, in the 'Porcupine' Expedition of 1869. In eighty fathoms eighteen miles W. of Skellig (J. G. J.); seventy fathoms in Dingle Bay; twenty-five fathoms off Valencia, S.W. Ireland; ninety to one hundred fathoms twenty-five to thirty miles W. of the Blasquet, S.W. Ireland, 26th May, 1870 (J. G. J.).

A conspicuous feature in the collection of Annelids made by the Fishery Board's ship 'Goldseeker' from the Firth of Forth northwards in the North Sea during the International Investigations. It occurred at more than thirty stations and generally at considerable depths. Many of the tubes show numerous and somewhat regular opalescent curves from internal membranous valves.

In various parts of the Atlantic and Mediterranean during the 'Porcupine' Expedition of 1870, and in the former case at considerable depths, *e.g.*, 795 fathoms. Marion thought it was both rare and small at Marseilles. Shores of France (De St. Joseph). Siberia (Wirén). Christiania Fjord and other parts of Norway (M. Sars). Off Bergen, Norway (Canon Norman). Off Fayal, Azores, coast of Buenos Ayres, off New Zealand,

Torres Strait, and Canary Islands ('Challenger'). Japan (J. P. Moore). West Indies (Augener). East Indies and Africa (Ehlers).

The wide distribution of this species and its varieties is noteworthy.

Head (Plate LIV, fig. 5 *a*) agrees generally with that in *O. conchylega*, the tentacles arising from ringed bases, and being long and smooth. No eyes. The anterior processes (frontal palpi, Pruvot, and palpi, Claparède) are somewhat pyriform and slightly marked by transverse wrinkles in life, but in spirit ovate. The palpi form two bulbous pads with a median furrow ventrally.

Body typical. The first segment is narrower than the succeeding, and is smoothly rounded from side to side. The mouth-parts (Plate LXV, fig. 15) present two bulbous processes at each side of the aperture, with the mandibles posteriorly.

Proboscis (Plate LXIV, fig. 5 *a*).—The maxillæ have a rather short hooked region anteriorly, the enlarged region extending far forward. The tips are sharp. The posterior processes are bluntly conical. A dark brown border to each runs forward and joins a transverse bar between them and the maxillæ, and from the centre a line passes obliquely outward on each side to a dark spot at the end of the great dental plate. The right great dental plate has teeth throughout nearly its entire extent, but they vary in number apparently according to the size and age of the specimen. In the examples from the 'Challenger' there are fourteen teeth. A British one had thirteen teeth; the left great dental plate has about thirteen. The left anterior curved plate has four, and the right anterior curved plate four. The mandibles have a slightly denticulated edge anteriorly, and long tapering shafts. The second segment is considerably broader and bears the first feet, which are proportionally massive organs directed forward with a disk-like process at the tip. The dorsal cirrus is somewhat short and stout, and arises from the mid-dorsal region of the foot. The posterior papilla springs from the tip of the foot behind the disk-like flap. It is subulate. The ventral cirrus, again, arises near the base of the foot ventrally. The setigerous region is supported by three spines, and a series of strong, bifid winged falcate bristles (Plate LXXXIV, fig. 8). The tip is strongly hooked, and beneath the hook is a prominent secondary process, closely resembling that in *Onuphis britannica*, though the attachment of the wing is nearer that process.

The second foot is considerably shorter and only slightly inclined forward, and as a consequence the cirri and papilla are nearer each other. It bears both simple bristles with a winged and tapering tip, and bifid hooks. The ventral cirrus forms a stout subulate process, that of the next foot (fourth), however, being shorter and its tip blunt. In the following three feet it gradually diminishes into the pad at the ventral edge of the foot. The lower bristles of the dorsal series in the anterior region, *e.g.*, the eighth foot (Plate LXXXIV, fig. 8 *d*), have shorter tips and broader wings.

At the tenth foot (Plate LXXV, fig. 11) is dorsally the proportionally large and somewhat fusiform dorsal cirrus—tapering, however, more toward the tip. The setigerous region has dorsally one or two long and rather stout bristles, with winged and tapering tips (Plate LXXXIV, fig. 8 *a*), besides a group of brush-shaped forms (Plate LXXXIV, fig. 8 *b*). Below is a group of similar bristles with broader wings and shorter tips. The hooks do not seem to be prominent in these feet. The papilla at the posterior

border of the tip is lanceolate, whilst the terminal process of the setigerous region is small. At the twentieth foot the dorsal cirrus is more elongate; the posterior papilla is shorter and more ovate, but the bristles have the same character. The setigerous region is about the same length as at the tenth.

The branchiæ commence from the twenty-third to the twenty-sixth foot as a simple filament, and continue almost to the posterior end.

At the thirtieth foot the dorsal cirrus has diminished to a slender subulate organ, whilst from the inner edge of its base arises a branchia more than twice its length and bulk, and slightly fusiform in outline. The setigerous region is considerably shorter, forming a short blunt cone with a trace of a papilla at the tip (and it disappears in the next foot). Dorsally (above the spines) is a group of three longer winged bristles with rather short tips. Brush-shaped bristles occur along with these. Then follow, below, two strong bifid hooks with wings (Plate LXXXIV, fig. 8 *c*). Ventrally are about three bristles with shorter tips and broader wings than those of the dorsum. The ventral pad is the only representative of the ventral cirrus. The branchiæ diminish in size posteriorly, as also does the dorsal cirrus, but the arrangement of the bristles and hooks remains the same.

Posteriorly the body diminishes to a somewhat flattened tail, the last segment of which is ovoid, with the anus on the dorsum and two long caudal cirri from the hind edge.

In an example procured in Norway by Canon Norman a subulate tentacular cirrus of some length sprang from the middle of the first segment nearly in a line with the long lateral tentacle of the right side. Such would seem to indicate that the absence or presence of these organs is not a matter of fundamental importance, though it may be a convenience in classification. In one of the British specimens a tail is being regenerated, and this is tipped with three long and slender styles, one of which bifurcates near the tip.

Fage[1] observes that the ectodermic portion of the segmental organ of this form is particularly well developed.

The tube (Plate LXIV, fig. 5 *b*) is a translucent horny structure, which the animal drags after it like the larval *Phryganea* (Pruvot)[2] or other aquatic form. Schmiedeberg[3] has found a peculiar substance in it, which he calls onuphin, as well as an albuminoid material.

Reproduction.—De St. Joseph gives the diameter of the eggs in ripe examples from St. Raphael at 0·24 mm., with a porous *zona radiata*.

The original description by O. F. Müller (1788) is as definite as his figures, and he specially points out the singular nature of its pellucid tube.

The tube of this form is represented in Plate LI, fig. 4, of Montagu's MS. drawings by Miss Dorville (1808) in the Linnean Society's collection.

Grube gave a brief description of the species from Mediterranean examples in one of his early papers.[4] He thought the dorsal longitudinal muscles smaller than in *Eunice*.

[1] 'Ann. Sc. nat.,' 9e sér., t. iii, p. 350, fig. 37 (genital funnel).
[2] 'Arch. Zool. expér.,' 2e sér., iii, p. 256.
[3] 'Mitth. Zool. Stat. Neap.,' iii, p. 373, 1882.
[4] 'Anat. u Physiol.,' Kiemenw., p. 45, 1838.

He mentions the ovaries in their correct position, and gives an account of other structural features.

Peach ('Rep. Zool.,' Ray Soc., 1847) thinks he had observed this form swimming on the surface of the sea, but Edward Forbes was of opinion that this was merely accidental. A dried form in a tube, or a tube with air in it, might float, but though active on the bottom there is no proof up to date that it is pelagic.

Dr. Johnston (1865), founding on the absence of pectinate branchiæ, placed this form under his genus *Nothria*. He made what he calls a vain attempt to form the tube into a pen.

Ehlers (1868) included the *Onuphis sicula* of De Quatrefages under this species, a view not held in the present work. Tauber followed him.

Schmiedeberg (1882), as indicated, made a chemical examination of the tube and found it analogous to chitin. It would be interesting to compare his results especially with regard to "onuphin" with those recently obtained by Prof. Irvine[1] at St. Andrews on a polarimetric method of identifying chitin in similar secretions in Crustacea, Mollusca, and Fishes. It may be that onuphin has some relation to mucin.

Pruvot[2] gave an account of the nervous system of this species in which the cerebral mass is large and pierced by the bases of the posterior lateral tentacles. The anterior lobes give origin to the stomato-gastric system of nerves, and not the œsophageal connectives. He shows a single central neural canal in the ventral cord. In the British examples the neural canal is nearer the ventral than the dorsal border. He could not find the ciliated pockets of Semper at the posterior part of the head. He found in the foot two ductless glands connected with the bases of the dorsal and ventral cirri, and a smaller third gland having a similar relation to the cirrus (or papilla) near the exit of the bristles at the tip.

Arnold Watson[3] carefully describes the valves formed in the tube of this species, the anterior being V-shaped, and the posterior zig-zag. The inrush of sea-water automatically closes the valves. The worm carries about its tube in its movements on the surface of the muddy ground it inhabits. From his experiments this observer found that the annelids could renew the valves when cut off and also of course add to their tubes.

Eisig[4] gives a detailed account of the movements of this species in its tube and when free. In its tube its motion is what he calls geometroid, and when swimming in the free condition he terms its action mastigo-helicoidal. It can secrete a new tube in a day.

[1] 'Trans. Chem. Soc.,' 1909, vol. xcv, p. 565.

[2] 'Arch. Zool. expér.,' 2e sér., iii, p. 256, 1885.

[3] 'Trans. Liverp. Biol. Soc.,' vol. xvii, p. 306, etc., figs. 1—4, 1903; and 'Rep. Brit. Assoc.,' Belfast, 1902, p. 652.

[4] 'Fauna u. Fl. Neap.,' xxviii, p. 263, 1906.

Genus LXX.—Eunice, *Cuvier*, 1817.

Head with five tentacles, cirrophore devoid of rings (Carus), two bulbous palpi, the second of the first two footless segments with tentacular cirri. Foot with dorsal and ventral cirri, simple dorsal bristles, compound ventral bristles, and branched or comb-like branchiæ. Four anal cirri. Upper jaw with teeth and fang, one plate more on the left than on the right side. (Audouin and Milne Edwards give seven plates.) Anal segment with two cirri.[1]

This genus corresponds with *Leodice*; Leodice simplices, Savigny; *Nereidonta*, De Blainville; and *Eunice*, De Quatrefages. Some, such as Grube, make a sub-genus *Leodice*, Savigny, characterized by having the margin of the head bilobate and with two tentacular cirri.

The body-wall is less massive than in *Lumbriconereis*, the dorsal longitudinal muscles especially being less compact. The nerve-area is situated immediately within the circular

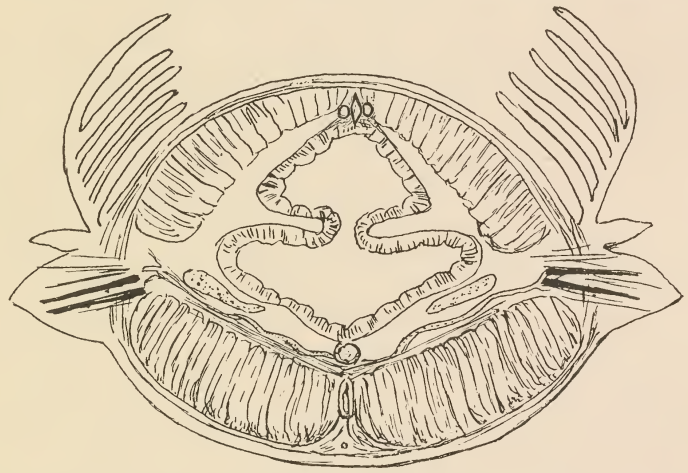


Fig. 84.—Transverse section of *Marphysa sanguinea*, Mont. The great size of the ventral longitudinal muscles is conspicuous. The dorsal blood-vessel (above the alimentary canal) has been cut along with a branch on each side.

coat and the basement-membrane, and forms a more or less ovoid area of firm consistence and with a neural canal toward the outer or ventral border. Jourdan[2] declines to consider this a colossal nerve-fibre either structurally or functionally. The oblique muscles pass down laterally, some of the fibres reaching the basement membrane.

1. Eunice fasciata, *Risso*, 1826. Plate LIV, fig. 1; Plate LXII, figs. 10 and 10 *a* —teeth; Plate LXXIV, figs. 7–7 *b*—feet; Plate LXXXIII, figs. 4 and 4 *a*—bristles.

Specific Characters.—Head comparatively small, bilobed anteriorly, with five tentacles of a dull yellow colour with olive-brown bars which are five in number on the median. Slight constrictions occur at the bars, and minute white grains cover the

[1] Benham (‘Camb. Nat. Hist.’) states that four are present.

[2] ‘Ann. Sc. nat.,’ 7e sér., t. ii, p. 262, 1887.

surface. Two white spots behind the median tentacle and one in front of it. Eyes at the base of the inner (posterior) paired tentacles. Body 6 to 9 ins. long, pale brownish red, with a dorsal streak from the blood-vessel and variegated with regular white markings. Anal cirri are enlivened with white grains and olive-brown bars. Second segment equal to about two-and-a-half of the succeeding, with a shield-shaped white spot in the centre of the anterior border, and two at each side. The next (also a footless segment) bears the tentacular cirri, and is marked by a central white spot and one on each side. The tentacular cirri have four olive-brown rings toward the distal half. The third body-segment is the type of the succeeding, having a white spot in the centre and three or four on each side, so that in series three longitudinal rows occur on each side anteriorly. The dorsal cirri are whitish.

Proboscis has the maxillæ moderately curved, and of a chocolate-brown hue, with a dark edge to the flange posteriorly in front of the spatulate appendages. The left great dental plate has seven teeth, the right six. The right anterior plate has six teeth, and a dark brown chitinous process supports it. The accessory patch on the outer side has a single tooth. The left anterior (curved) plate has six teeth and a horny inner edge; accessory outer plate a single tooth. The left azygos plate has seven or eight teeth. Mandibles have the anterior edge sloped outward with a tooth at the inner third, and are marked by concentric lines. First branchial process (a simple filament) occurs on the fourth bristled segment; next three segments have two, three, and four divisions of the branchial process, the eighth foot has eight divisions and the tenth about twelve, so that the semi-pinnate arrangement is marked. The maximum development of the branchiæ takes place in the anterior third of the body. At the fortieth foot the processes have diminished to nine, at the fiftieth to five, and at the seventieth foot to three. Gradually diminishing in number they are represented in the caudal region by a single filament as in front. At the tenth foot the branchial divisions are ten, and the dorsal cirrus extends beyond the bristles. The dorsal bristles are winged and tapered, and there are brush-shaped bristles at their bases. The jointed bristles have shafts curved and dilated at the end, and a short terminal piece bifid at the tip and with guards. The setigerous region has three yellow spines. A powerful ventral hook with wings appears before the thirtieth foot, and continues to the posterior end.

Synonyms.

1826. *Leodice fasciata,* Risso. Hist. Nat. Prod. de l'Europe, t. iv, p. 421.
1833. *Eunice Harassii,* Aud. and Edw. Ann. Sc. nat., t. xxviii, p. 215, pl. xi, f. 5—7, 10, and 11.
1834. „ „ idem. Annél., p. 141, pl. iii, f. 5—7, 10, and 11.
1838. „ „ Grube. Anat. u. Physiol. Kiemenw., p. 35, Taf. ii, f. 1—9.
1840. „ „ idem. Actin. Echin. u. Würm., p. 83.
1851. „ „ idem. Fam. Annel., pp. 44 and 123.
1864. „ „ Claparède. Glanures Zoot., p. 118, pl. ii, f. 5.
„ „ „ Grube. Insel Lussin, p. 79.
1865. „ „ Johnston. Cat. Worms Brit. Mus., pp. 132 and 340.
„ „ „ De Quatrefages. Hist. Annel., i, p. 307.
„ „ *fasciata,* idem. Ibid., p. 330.

1868. *Eunice Harassii,* Ehlers. Borstenw., ii, p. 312, Taf. xiii, f. 15—21; Taf. xiv; Taf. xv, f. 1—3.
1870. ,, ,, Baird. Journ. Linn. Soc., vol. x, p. 346.
,, ,, ,, Grube. Arch. f. Naturges., Bd. xxxvi, p. 294.
1874. ,, *Claparedii,* Marenzeller. Adriat. Annel., p. 57.
1875. ,, ,, Ehlers. Zeitschr. f. wiss. Zool., xxv, p. 52.
1879. ,, ,, Langerhans. Ibid., xxxiii, p. 294.
1890. ,, *Harassii,* Malaquin. Annél. Boulon., p. 24.
1891. ,, ,, Hornel. Trans. Biol. Soc. Liverp., vol. v, p. 239 (?).
1893. ,, ,, Marenzeller. Zool. Ergebn., ii, p. 9.
1895. ,, ,, Pruvot and Racovitza. Arch. Zool. expér., 3e sér., t. iii, p. 384, pl. xvii, f. 48—58; and pl. xviii, f. 69.
1896. ,, ,, Roule. Camp. 'Caudan,' p. 445.
1903. ,, *fasciata,* McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 557.
,, ,, ,, idem. Ibid., ser. 7, vol. xii, p. 136.
1905. ,, *Harassii,* Graeffe. Arbeit. Zool. Stat. Triest., xv, p. 321 (?).
,, ,, *torquata* (syn. *Harassii,* Aud. and Edw.), idem. Ibid., p. 321 (?).
1906. ,, *Harassii,* De St. Joseph. Ann. Sc. nat., 9e sér., t. iii, p. 201, pl. iv, f. 76 (*juvenis*).
,, ,, ,, Bohn. Ibid., 9e sér., t. iii, p. 101.

Habitat.—Dredged in fifteen fathoms off Fermain Bay, Guernsey, on shell-gravel, and also procured between tide-marks, St. Peter Port (W. C. M.). Off the Hebrides and off Inverary; in 160 fathoms, fifty-five miles west of Valentia, Ireland (J. G. Jeffreys). In seventy-five fathoms on mud with stones and mussel-shells—'Porcupine,' 1869—Station XXXIV; and in 80—110 fathoms on muddy sand with pebbles in the same Expedition. Very fine examples are procured between tide-marks, Herm. S.W. Ireland, log 56 (R. I. A. Expedition). Jersey (Hornell).

St. Vincent, Cape Verde Islands ('Challenger'). St. Malo, Isles de Chausey, Dinard, and other shores of France (De Quatrefages, De St. Joseph). Off Cape Guardia, and in eighty-one fathoms off Cape Finisterre, 'Porcupine' Expedition, 1870.

Head bilobed anteriorly from the great palpi, comparatively small and crowded with the five tentacles, the median being the longest. The ground colour of the tentacles is dull yellow, with olive-brown bars. These organs do not taper much and seem to be proportionally thick, slight constrictions occurring at the olive-brown rings, which are five in number on the median tentacle, the most distinct being at the terminal ring. Minute white grains also occur on the tentacles. Behind the median tentacle are two white spots on the head and one in front of it. A few others occur near the base of the lateral. A well-marked eye lies externally at the base of the inner lateral tentacle and behind the shorter external tentacle.[1] The prominent posterior edge of the cephalic segment is dark brown, and the slope of the ridge light brown, the whole defining the region very distinctly.

Body 6 to 9 ins. in length, rounded in extension, flattened in contraction, and of a fine pale brownish-red colour, with a dorsal streak from the blood-vessel, and variegated with regular white markings. It is slightly tapered anteriorly, and distinctly so pos-

[1] A careful account of the minute structure of the eye of this form and of other annelids is given by Von Graber, 'Arch. f. Micros. Anat.,' xvii, p. 243, pls. 28—30.

teriorly, the slender tail terminating in the anus, beneath which are two long cirri variegated with white grains and olive-brown bars.

The second segment is equal to about two and a-half of the succeeding, and has a slightly projecting collar at each side anteriorly. A shield-shaped white spot occurs in the centre of the anterior border, a smaller spot on each side, and another to the outer side and a little in front of the last. A short subdivision (forming the footless segment of some) bears the tentacular cirri posteriorly, and it has a considerable white spot in the centre posteriorly and one on each side, the tentacular cirri springing from the anterior border of these two. The spots and the tentacular cirri are pure white, and the latter have about four olive-brown rings towards the distal half. Another white patch occurs on the side beneath. The third segment is the type of the succeeding, having a white spot in the centre of the dorsum, and three or four on each side (not on the bases of the feet), so that three longitudinal rows occur on the dorsum anteriorly. In this segment one or two whitish touches appear at the anterior border, and the speck in the centre is pale. The rows of spots continue to the tail, and the lateral, which are less white, also do so, though the general speckling of the dorsum renders them less marked. The dorsal cirri are whitish and add considerably to the elegant aspect of the animal. The ventral surface is uniformly iridescent pinkish throughout.

A pale specimen between 8 and 9 ins. in length, procured between tide-marks in Herm, shows only the anterior region of a faint reddish-brown. The rest is dull whitish or greyish, with a reddish-brown streak from the intestine and blood-vessel. The whitish marks throughout are also very indistinct.

Proboscis.—The maxillæ (Plate LXII, fig. 10) are strong, moderately curved, and of a chocolate hue, with a dark edge to the flange posteriorly, the appendages in the rear being spatulate. The left maxillary plate has seven teeth, the right six. The curved plate in front of the right has six teeth, and a dark brown chitinous process supports it anteriorly. The accessory patch on the outer side has a single tooth. On the left the curved plate has six distinct teeth and a horny inner edge not evidently denticulated. The accessory outer plate has a simple conical edge. The left azygos plate has seven or eight teeth. The mandibles (Plate LXII, fig. 10 *a*) have the anterior edge sloped forward and outward, with a tooth at the inner third, and are slightly marked by concentric lines. The limbs are pointed posteriorly. Occasionally a shelf-like flap occurs below the cutting edge, as in the figure.

The first branchial filament is simple and springs from the fourth bristled segment, though slight variations are met with. It is attached to the inner base of the dorsal cirrus. The next three segments have respectively two, three, and four divisions of the branchial process, whilst the eighth foot has about eight divisions and the tenth about a dozen. Some of the segments have branchiæ with fifteen divisions, forming a long bright red semi-pinnate process of great beauty. Their maximum development takes place in the anterior third of the body, so that at the fortieth foot they have diminished to nine, at the fiftieth to five, and at the seventieth to three. Gradually diminishing they are represented in the caudal region by a single filament as in front.

The first foot has a long and rather thick dorsal cirrus, and a ventral lobe or cirrus of a massive conical outline. The setigerous lobe is bluntly conical, with two pale spines.

It bears dorsally a small tuft of tapering, simple bristles, and below the spines a series of jointed bristles, the shafts of which are curved and dilated toward the tip, which is bevelled and marked by oblique striæ. The terminal piece is bifid, with guards at each side, as in the succeeding feet.

At the tenth foot (Plate LXXIV, fig. 7) the divisions of the branchiæ are ten in number, the dorsal cirrus extends beyond the bristles, and there are three spines. The superior bristles have the same type as in front (Plate LXXXIII, fig. 4). The brush-shaped bristles at the base of these show no peculiarity. The inferior bristles agree with those in front (Plate LXXXIII, fig. 4 *a*), though the terminal piece is less elongated. They form a dense group.

The thirtieth foot has three spines, the tips of which project beyond the setigerous region. The bristles are as in front. The ventral cirrus is a short process, which projects beyond the great ventral pad. The fortieth foot has also three spines, besides a powerful ventral hook (with wings) issuing just above the ventral cirrus, which now is elongated. The fiftieth is similar. At the seventieth foot the setigerous region has diminished in size, and has two spines. The great inferior hook is well marked, and the ventral cirrus (lobe) is longer.

The ninetieth foot (Plate LXXIV, fig. 7 *a*) has three spines, the middle one being the longest, and the tips of all being distinctly curved. The great hook with its crest projects below the ventral cirrus. Near the tip of the tail (Plate LXXIII, fig. 7 *b*) two sharp spines occur in the somewhat deep setigerous region. The jointed ventral bristles are comparatively large, and the great hook projects inferiorly. The ventral cirrus is bent upward and is comparatively long.

So far as can be made out the *Leodice fasciata* and *L. punctata* of Risso[1] refer to this form; indeed, his description is fairly good.

Grube (1838) in one of his early papers gave a careful account of the external and internal structure of this species, with accompanying figures.

The head of a gorgeously coloured *Eunice* on Plate 142 of Delle Chiaje's 'Descrizione' (fig. 7) may be that of this species, though the gill represented in fig. 9 resembles that of *E. aphroditois*.

Claparède (1864) describes a well-marked variety of a vinous red colour with a white band on the head, as well as on the first and fourth segments bearing feet, and with the tentacles, and the tentacular and dorsal cirri, variegated with white and red.

It is doubtful if the *Eunice Claparedii* of De Quatrefages[2] is other than a variety of *E. fasciata*.

An elaborate structural account of the species is given by Ehlers (1868), and also a description of the reproduction of the tail.

Pruvot (1885) examined the nervous system of *Eunice torquata*, a form which approaches very closely to this species. It agrees generally with the arrangement in *Hyalinœcia tubicola*, but the origin of the œsophageal connectives is double, and the large neural canal is nearer the ventral border.

[1] 'Hist. Nat. de l'Europe,' t. iv, p. 421, 1826.
[2] 'Annel.,' ii, p. 652, 1865.

Pruvot and Racovitza (1896)[1] distinguish between this form and *E. torquata*, De Quatrefages. Thus the colour of *E. torquata* is generally brown, and the sixth segment is always coloured white on the dorsal surface. Median tentacle only as long as the first four segments, whereas in *E. fasciata* it is as long as eight. All the appendages are moniliform, with brown bars. Branchiæ begin on the fifth segment and go to the posterior end, with the exception of the last twenty-five in an example of 140 segments. Maximum divisions of branchiæ between seventeenth and thirty-eighth are about ten. Spatulate bristles with a long filament at both edges, whereas in *E. fasciata* there is only a long filament on one edge. Aciculi black and without valves—whereas those of *E. fasciata* are brown, with two valves. Dental plates support a third which is the length of the mandibular piece (this refers to the maxillæ and the posterior piece).

Some of these distinctions are doubtful, but certainly the black spines are characteristic.

Hornel (1891) shows a form which he refers with doubt to *E. fasciata*, with a maximum of twenty divisions to the branchiæ.

Gravier[2] records *E. fasciata* as a temporary commensal in *Ostrea edulis* from Coutances on the shores of France. It does not seem to interfere with the mollusk, the microscopic food of which would not offer much temptation to a form which habitually selects Crustaceans, Annelids, Bryozoa, and Synaptæ. Moreover *Phyllodoce rubiginosa*, *Nereis Dumerilii*, and *Lagisca extenuata* were found under the same circumstances, thus probably pointing to accidental commensalism.

A form dredged off the Hebrides (in the Minch) by Dr. Gwyn Jeffreys in July, 1866, shows certain marked differences from *E. fasciata*, though apparently resembling it. Thus the branchiæ commence on the third foot, speedily increase in the number of filaments, which in those best developed are fifteen, then gradually diminish, and cease at the forty-seventh foot. The absence of branchiæ throughout the rest of the body posteriorly thus differs from the condition in *E. fasciata*. It agrees with *E. fasciata* in the maximum number of the pinnæ of the branchiæ, but these go no further than the forty-seventh foot.

The general form of the dental apparatus is similar, but the great dental plates have seven teeth on the left, and eight on the right, the first on that side being occasionally bifid. The azygos plate has eight teeth; the curved plate in front about the same number, and only one continuation plate with a smooth edge is present beyond the latter (absent on the left from rupture). On the right the anterior curved plate has about twelve teeth, and a single flat plate with a smooth edge continues the curve.

The appendages to the maxillæ form together a spathulate process. The mandibles are similar to those of *E. fasciata*, with a tooth at the inner third of the anterior edge.

The foot likewise diverges from that of *E. fasciata*. At the tenth there are at most ten divisions of the branchiæ. The setigerous region is less prominent and the ventral cirrus forms a smooth pad without the terminal process of *E. fasciata*. The dorsal bristles do not differ much, but the jointed ventral have the first or proximal point of the hook directed straight outward and not distally inclined as in *E. fasciata*. The edge of

[1] 'Arch. Zool. expér.,' 3e sér., t. iii, pp. 384, 389, et seq.

[2] 'Bull. Mus. Hist. Nat. Paris,' vi, p. 415, 1900.

the terminal piece is serrated and so is the edge of the enlarged end of the shaft. A small process appears at the tip of the ventral cirrus at the twentieth and a larger at the thirtieth and fiftieth, so that this may be a question of degree. The spines are yellow, as in *E. fasciata*.

A similar form comes from the 'Porcupine' Expedition of 1870, sixty-five miles W. of Valentia, S.W. Ireland, at a depth of 160 fathoms. The branchiæ had only eight branches as the maximum number, but the specimen is smaller.

The same form with eight branches to the branchiæ comes from an area twenty-five miles N.N.E. from Unst, Shetland, in ninety-five fathoms, 1868 (Dr. Gwyn Jeffreys).

A Norwegian Eunicid dredged by Canon Norman approaches *E. fasciata* in some respects, the branchiæ commencing on the fourth foot and extending to the thirty-seventh foot or thereabout. The number of pinnæ on the larger branchiæ appear to be much less than in *E. fasciata*, being only six to eight, generally six.[1]

So far as known *E. fasciata* does not harbour the crustacean entoparasites (*Eunicicola Clausii*, Kurz.) found for instance in *E. Claparedii*.

2. Eunice vittata, *Delle Chiaje*, 1829. Plate LXIII, figs. 3 and 3 *a*—teeth; Plate LXXIV, figs. 10–10 *b*—feet; Plate LXXXIII, figs. 7–7 *b*—bristles.

Specific Characters.—Head pale, with an evenly rounded anterior margin of the fused palpi, which, however, show a deep ventral furrow. Five long smooth tentacles. Eyes large and black, in the normal position. Body slender, 2—3 ins. long. First segment about thrice the breadth of the succeeding. The second bears two slender tentacular cirri at its anterior border. Each in life has a white spot at its base. The anterior third or fourth of the dorsum is pale brown, posteriorly it is pale fawn. The pale madder-brown aspect anteriorly is due to the pigmentation of the general surface, and also to brownish belts which cross the segment at the anterior border. A dark spot occurs at the base of each foot. Branchiæ commence on the third foot as a simple filament or two. On the tenth foot there are four divisions, on the twentieth five, the same number being on the thirtieth. The fortieth has four, the fiftieth two, and the sixtieth one, and so to the eighty-seventh, the branchiæ ceasing only on the last seventeen or eighteen segments. Tenth foot has dorsally the cirrus with its supporting spines, the tips of which pass into the cirrus beyond the origin of the branchiæ, which show four nearly equal divisions. Setigerous region bluntly conical, the points of two yellow spines projecting at the tip. Superiorly are simple bristles slightly dilated at the commencement of the tapered, serrated tip so as to give the organ the advantage of wings. Beneath the spines is a dense tuft of compound bristles, the shafts being translucent, bevelled at the tip, and marked by striæ directed downward and backward. The terminal piece is rather broad and short, is bifid, and has wings. Posteriorly the chief changes in the foot are the less prominent condition of the setigerous region, the diminution in the number of the bristles, and the presence of the powerful hook, the crown of which (above the fang) is often bifid.

[1] Marenzeller's remarks show that considerable confusion exists between this species and *E. torquata, E. Claparedii,* and allied forms ('Sitzb. k. Akad. Wiss. Wien,' Bd. lxix, p. 57).

Synonyms.

1829. *Nereis vittata,* Delle Chiaje. Mem., iv, pp. 176, 195, Tav. lxiv, f. 12 and 13.
1841. „ „ idem. Descriz., iii, p. 94; v, p. 101, Tav. 166, f. 12 and 13.
1851. „ *minuta* (juv.), Grube. Fam. Annel., pp. 44 and 123 (?).
1864. „ *vittata,* idem. Insel Lussin, p. 79.
1865. „ *Rissoi,* De Quatrefages. Annel., t. i, p. 315.
„ „ *Laurillardi* (partim), idem. Ibid., p. 314.
1868. „ *vittata,* Claparède. Annél. Nap., p. 133, pl. vi, f. 3.
„ „ *limosa,* Ehlers. Borstenw., ii, p. 348, Taf. xv, f. 15—22.
„ „ *rubrocincta,* idem. Ibid., p. 344.
1870. „ *vittata,* Claparède. Suppl. Annél. Nap., p. 34.
1875. „ „ Marion and Bobretzky. Ann. Sc. nat., 6e sér., t. ii, p. 11.
1876. „ *limosa,* McIntosh. Proc. Roy. Soc., xxv, p. 217.
1879. „ *vittata,* Langerhans. Zeitschr. f. wiss. Zool., xxxiii, p. 293.
1885. „ „ Carus. Fauna Medit., i, p. 210.
1900. „ „ Fischli. Polych. Ternate (Moluccas), p. 104 (Abhand. Senek. Natur. Gesell., Bd. xxv).
1903. „ „ McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 558.
1904. „ „ Moore. Proc. Acad. Nat. Sc. Philad., vol. x, p. 435.
1905. „ „ (syn. *Claparedii* ?), Graeffe. Arbeit. Zool. Stat. Triest, xv, p. 321.
1906. „ „ De St. Joseph. Ann. Sc. nat., 9e sér., t. iii, p. 204.
„ „ „ Eisig. Fauna u. Fl. Neap., xxviii, p. 213.
1908. „ „ Ehlers. Deutsch. Tiefsee Exped., p. 87.
1909. „ „ Lo Bianco. Mitth. Zool. Stat. Neap., Bd. xix, p. 580.

Habitat.—Dredged off St. Peter Port, Guernsey, on shelly ground in fifteen fathoms in a tube composed of broken shells and stones inside the valve of a large mussel, and in cracks of leathery tube in another shell at the same depth. This form seems to frequent water from fifteen to twenty fathoms or more in depth. 'Porcupine' Expedition, 1870, Stations XXVII, XXVIII, and XXVIII *a*. Galway (A. G. Moore); Polperro (W. Baird); and Plymouth (C. S. Bate).

Shores of France (De St. Joseph). Madeira (Langerhans). Mediterranean (Delle Chiaje, Grube, Claparède). Japan (Moore). Adventure Bank, 'Porcupine,' 1870, ninety-two fathoms. Cape Verde Islands (Ehlers).

Chiefly a southern form—widely distributed.

Head with an evenly rounded anterior margin of the fused palpi, which, however, show a deep ventral furrow. It bears five long smooth tentacles, the median being the longest, whilst the infero-lateral is little more than half the length of the superior. The eyes are large and black, and they hold a similar position to those of *E. fasciata*. The head and tentacles are pale, and the latter are smooth under a lens.

Body slender, 2—3 ins. long, slightly tapered anteriorly, and forming a slender tail posteriorly. The first two segments are devoid of feet, the first being about thrice the breadth of the succeeding. The second bears the two slender tentacular cirri at its anterior border. In life each of these has a whitish spot at the base. The last six or seven segments in front of the vent have very thin dorsal walls, so that even in spirit-preparations the intestine is clearly visible. Such probably aids in respiration. Dorsum

for the anterior third or fourth of a pale brown colour, posteriorly of a pale flesh colour, and so to the tip of the tail. The slightly madder-brown hue anteriorly is due to the faint pigmentation of the general surface, but more particularly to brownish belts (red or roseate, De St. Joseph), which cross the segments at their anterior border, and which sharply define the segment-junctions. One of the striking characteristics is the presence of a dark spot at the base of each foot, very distinct posteriorly. Ventral surface pale.

The branchiæ commence on the third foot as a simple filament or as two filaments, though in those from the 'Porcupine' some show three branches on this foot. On the tenth foot are four divisions, on the twentieth five, the same number being on the thirtieth. The fortieth has four, the fiftieth two, and the sixtieth one. The latter number occurs on the seventieth and the eighty-seventh, the branchiæ ceasing only in the last seventeen or eighteen segments. Variations, however, are frequent. Claparède mentions that they are ciliated, a feature rarely present in the Eunicidæ.

The body-wall in this form is less compact, both dorsal and ventral longitudinal muscles being extended in transverse section. The nerve-area is within the circular coat, having the basement-tissue, hypoderm, and cuticle externally. No neural canal is visible. The oblique muscles are attached at the sides of the area.

Proboscis.—The maxillæ (Plate LXIII, fig. 3) are well developed, and have no shoulder at their posterior articulation. The left great dental plate has nine or ten teeth, the right ten; azygos plate seven to ten; left anterior plate six or seven, and the right ten teeth. On each side in front of these is a brown nodule. A dark brown pigment-band marks the articulation between the maxillæ and the posterior processes, and passes down each side of the articulation between them, and another curved band bounds the hind border of the dental plates a little in front of the articulation. The posterior processes are somewhat lobate in shape, usually with bluntly rounded posterior edges, the specimen figured being exceptionally narrow and pointed. The mandibles (Plate LXIII, fig. 3 *a*) have an oblique cutting edge, often with a gap.

The first foot has a long dorsal cirrus, and a conical ventral lobe with two pale spines and dorsal and ventral bristles. The second foot is similar to the first, only the setigerous region is clearly differentiated from the ventral lobe (cirrus). The third foot has two pale spines, and the setigerous region is more distinctly separated from the ventral lobe. The dorsal cirrus is still long, and bears a single branchial filament, a condition Ehlers also found in a large example, though he figures and describes the first branchia as having six divisions. The condition, indeed, is variable, some of the British forms having one or two, the latter being the number in the largest example (from Galway).

The tenth foot (Plate LXXIV, fig. 10) has dorsally the cirrus, which is slightly enlarged beyond the origin of the branchia at its base, and which has a tuft of simple bristles, the tips of which pass to the dorsal border of the cirrus beyond the branchia, which has four nearly equal divisions. The setigerous region beneath is bluntly conical, the points of the two yellow spines projecting at the tip. Above the spines is the tuft of simple bristles (Plate LXXXIII, fig. 7), slightly dilated at the commencement of the tip, and finely serrated, no brush-shaped bristles being visible in the preparations. Beneath the spines is the dense tuft of compound bristles (Plate LXXXIII, fig. 7 *a*), the shafts being translucent, bevelled at the tip, and marked by striæ directed downward and back-

ward. The terminal piece is rather broad and short, is bifid, and has wings. The ventral cirrus has a large granular swelling at its base, its own outline being conical. The foot generally is vascular. The same type of structure remains at the twentieth foot (Plate LXXIII, fig. 10 *a*), except that the blood-vessel going to the branchia is larger, and the organ has five divisions, as has also the thirtieth foot, but the great hook has now appeared below the jointed bristles. The basal enlargement at the ventral cirrus has disappeared at the fortieth foot, and the setigerous region is less prominent, a feature still more characteristic of the posterior region, where both kinds of bristles are fewer. In the terminal segments the dorsal bristles are shorter, but the jointed, though few, are prominent, as also are the great hooks (one in each foot). The crown of the hook (above the fang) is often bifid (Plate LXXXIII, fig. 7 *b*).

Reproduction.—Lo Bianco[1] gives September as the month in which the Neapolitan examples are mature.

Habits.—It is a vivacious and irritable species, and breaks if much interfered with. Eisig[2] found this form very agile on the ground, paddling its way over the sand, and an active swimmer. It also readily secretes a tube, and covers it with sand. When decapitated the head is reproduced in about nine weeks.

Delle Chiaje, in his 'Memorie,' 1829, describes and figures what apparently is this form as *Nereis zonata* and *N. vittata*, though the tints are brighter than in northern waters, and the arrangement of the gills and other features are not very accurately figured by the artist of the Italian naturalist.

Ehlers (1868) re-described this as a new species in the second volume of his 'Borstenwürmer' from examples procured at Quarnero in the Adriatic.

Claparède (1868) found an example devoid of the third (smaller) transverse brown band in the segment, and it would appear that this species is more definitely pigmented in the Mediterranean than in the north. This author pointed out the identity of Delle Chiaje's *Nereis vittata* with this species, though the figures are far from being accurate in detail. The same author (Claparède) in his Supplement (1870) observes that on the forty or fifty last segments, devoid of branchiæ, he found a pigment spot at the base of each foot, forming a minute eye with a lens. Similar spots occur in *E. fasciata*, *E. rubrocincta*, and *Hyalinœcia rigida*, but they are less superficial.

3. EUNICE NORVEGICA, *L.*, 1766 (= PENNATA, *O. F. M.*). Plate LXIII, figs. 4 and 4 *a*—teeth; Plate LXXIV, figs. 11 and 11 *a*—feet; Plate LXXV, figs. 1 and 1 *a*—feet; Plate LXXXIII, figs. 8 and 8 *a*, and 9–9 *c* for var. BA.—bristles.

Specific Characters.—Head with five long tentacles, which in spirit have an articulation at the tip. Eyes two, of considerable size, black. Palpi fused, leaving a deep notch in front and a deep groove ventrally, whilst superiorly they are pitted. Body 6—8 ins. in length. First segment three or four times the breadth of the second, with a lateral notch on each side ventrally. The second segment is even narrower than the succeeding.

[1] 'Mitth. Zool. Stat. Nap.,' xiii, p. 486.
[2] 'Fauna u. Fl. Neap.,' xxviii, p. 213.

It bears the tentacular cirri. Colour pale brown, iridescent. Proboscis with strong maxillæ, the curve of which is rather flat, whilst the tips rise little above the horizontal. A marked shoulder exists posteriorly, internal to which is a longitudinal ridge which alternates with that of the opposite side and interlocks. The maxillæ articulate with spatulate processes posteriorly. Great dental plates have seven teeth—largest in front. Left azygos plate has nine teeth, and the curved plate adjoining six teeth, and there are also two separate brown denticles. Right anterior curved plate has ten small teeth, and a larger and a smaller denticle continue the series as on the left. On the ventral surface is a slender horny bar between the anterior curved plates and the great dental. Mandibles with a denticulated anterior edge to the white oral plate; posterior limbs taper to a blunt point, and are brownish grey with a darker internal edge. Branchiæ commence as short subulate processes on the fourth foot—as a rule. Three divisions occur on the eighth foot. The twelfth foot has only two. Those following generally have two, occasionally three, then diminishing to one; they cease about the fortieth foot. The highest number of branchial filaments noticed was four, but in some young specimens it was three. The typical foot has dorsally the cirrus of moderate length, with the bifid or trifid branchiæ. The setigerous region is bluntly conical, supported by two black spines (pale in young examples). Dorsal bristles, long and simple, flattened and widened before tapering to the delicate tip; also a series of brush-shaped forms. Ventral bristles have a short, bifid, terminal piece, considerably narrower than the dilated end of the shaft. The large posterior hooks have a powerful terminal fang and a strong spike above it.

Synonyms.

1767. *Nereis norwegica*, Linneus. Syst. Nat., ed. 12, i, pt. 2, p. 1086.
1768. „ *madreporæ pertusæ*, Gunner. Trondhj. Selsk. Schrift., iv, pp. 41—51, Tab. 2, f. 6—12.
„ „ „ „ Ibid. Mus. Kircher, Class 12, p. 412, f. 8, 9, 10.
1776. „ *pennata*, O. F. Müller. Zool. Danic. Prod., p. 217, No. 2630.
„ „ *pinnata*, idem. Ibid., p. 217, No. 2629.
1788. „ *pennata*, idem. Zool. Danica, i, p. 30, Tab. xix, f. 1—3.
„ „ *pinnata*, idem. Ibid., p. 31, Tab. xix, f. 4—7.
1791. „ „ Linn. Syst. Nat. (Gmelin), ed. 13, i, pt. 6, p. 3116.
1806. „ *norvegica*, Turton's Linnæus, iv, p. 87.
„ „ *pinnata*, idem. Ibid.
1818. *Leodice norvegica* et *N. pinnata*, Lamarck. Anim. s. Vert., 1st edit., v, p. 323; 2nd edit., v, pp. 562, 563.
1820. „ *norwegica*, Savigny. Syst. Anim., p. 51.
1827. *Leodice pinnata*, Bruguière. Encycl. Mèth., Vers. i, p. 134, Tab. lvi, f. 1—4.
1828. *Nereidonta norvegica*, De Blainville. Dict. Sc. Nat., lvii, art. Vers., p. 476.
„ „ *pinnata*, idem. Ibid., p. 476.
1834. *Eunice norvegica*, Audouin and Edwards. Annél., p. 145.
1835. „ „ Sars. Beskriv. og Iagtt., p. 48.
1836—7. „ „ Cuvier. Règne Anim., iii, p. 100.
1844—5. „ *norwegica*, Œrsted. Kröyer's Nat. Tids., Bd. i (Drøbak), p. 406, pl. v, f. 13—15.
1851. „ „ Grube. Fam. Annel., pp. 44, 123.
„ „ *norvegica*, Sars. Nyt Mag. f. Naturvid., vi, p. 209.

1858—9. *Eunice norvegica*, Danielssen. Reise, 1857, p. 50; 1858, p. 116.
1865. „ „ Johnston. Cat. Worms Brit. Mus., p. 131.
„ „ „ De Quatrefages. Annel., i, p. 324.
„ „ *pinnata*, idem. Ibid., p. 325.
„ „ *annulicornis*, Johnston. Cat. Worms Brit. Mus., p. 131.
1867. *Leodice norvegica*, Malmgren. Annul. Polych., p. 64.
1868. *Eunice* „ Ehlers. Borstenw., ii, p. 347.
1869. *Leodice* „ McIntosh. Rep. Brit. Assoc. (1868), p. 339.
1870. *Eunice* „ Baird. Journ. Linn. Soc., vol. x, p. 345.
1873. *Leodice* „ Sars. Bidrag Christ. Fauna, p. 22 (sep. copy).
1874. *Leodice* „ Malm. Göteb. vet. o. vitt. Handl., xiv, p. 85.
1875. *Eunice* „ Möbius. Jahresb. Comm. deutsch. Meere, p. 168.
„ „ „ Ehlers. Zeitsch. f. wiss. Zool., Bd. xxv, p. 53.
1879. *Leodice* „ Hansen. Nyt Mag. f. Naturvid., xxiv, p. 268.
„ „ „ Tauber. Annul. Danic., p. 102.
1881. *Eunice* „ Horst. Niederl. Arch. Zool., Suppl. Bd. i, p. 13.
1883. *Leodice* „ Levinsen. Vidensk. Meddel. Foren. Kjöbenh., p. 229.
1893. „ „ idem. Vidensk Ud. "Hauchs," p. 331.
1902. *Eunice pennata*, Marenzeller. Polychæt. des Grundes, p. 16.
1903. „ „ McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 558.
„ „ „ idem. Ibid., vol. xii, pp. 137 and 164.

Habitat.—Dredged off Inverary by Dr. Gwyn Jeffreys in July, 1866. One was in a tube in a valve of *Pecten*. At Station XXXIV 'Porcupine' Expedition of 1869, in 725 fathoms on mud and sand, and a variety in 539 fathoms in grey mud in the Expedition of 1870. Off Balta in fifty and ninety-five fathoms. Dredged fifty-five miles west of Valentia, Ireland, in sixty fathoms (J. G. Jeffreys).

Amongst corals and mud, Norway (Canon Norman); Adria (Marenzeller); forty-five fathoms off Cape Sagres, 'Porcupine,' 1870. Extends to Canada (coll. Dr. Whiteaves).

Head with five long tentacles, the median being longer than the others, and in spirit presenting an articulation at the tip.[1] The adjoining pair have a tendency to further crenulation at the tip, whilst the external pair, which are considerable shorter, have a still more evident crenulation. In origin the median tentacle is most posterior; the outer lateral arise in front of the other three. The eyes are of moderate size, black, and lie in a line behind the outer lateral tentacles, and to the exterior of the bases of the inner lateral tentacles. The palpi are fused, leaving, however, a deep notch in front and a deep groove ventrally. The palpi are excavated or pitted superiorly.

Body 6—8 ins. in length, little tapered anteriorly, but gradually diminishing to a slender tail posteriorly, where it terminates in two long caudal cirri beneath the vent. In the preparations it is rounded dorsally, and somewhat flattened ventrally. The first segment is three or four times the breadth of the second, and has a well-marked lateral notch on each side, and its front edge is concave from side to side ventrally. The second segment is even narrower than the succeeding, and carries dorsally the two tentacular cirri, which are slightly crenulate in spirit, and reach fully to the anterior border of the first segment. Like the other processes they are tapered.

[1] Müller's *N. pennata* had non-articulate tentacles.

The proboscis has a strong pair of maxillæ, the curve of each of which is rather flat. In lateral view the tips rise very little, so that the organs are nearly horizontal. Posteriorly the outer angle of each maxilla is slightly elevated and projects as a prominent external shoulder. Within this is a definite raised longitudinal ridge, which alternates with that of the opposite side, so that the one fits into a pit superiorly, the other inferiorly—thus locking the jaws securely together, especially against vertical motion. Moreover, as the maxillæ fit into a crescentic hollow of the great dental plate, additional security is given to the grasp of food or living prey (Plate LXIII, fig. 4). Each maxilla articulates with a spatulate process posteriorly. The great dental plates are powerful and each has seven teeth, the largest in front. These teeth appear to have a scissor-like action, the left passing over the right. Rather more than a third of the posterior edge is smooth. The first antero-lateral plate on the left is further backward than that on the right, and forms what has been termed an azygos plate with nine teeth. It is also less arcuate than that on the right. The curved plate next it has six teeth, and there are two brown denticles—a larger and a smaller—which continue the row, and each has a terminal denticle. The right anterior curved plate has ten or more small teeth, and a larger and a smaller denticle continue the series beyond it, as on the opposite side. On the ventral surface a slender horny bar occurs on each side between the curved plates and the great dental, but it is disconnected, and there is no horny bar going to the maxillæ as in other forms.

The mandibles (Pl. LXIII, fig. 4 *a*) are powerful, the anterior oblique edge being denticulated, and the oral plate (which, as usual, is most extensive ventrally) is white. The posterior limbs taper to a blunt point. They are brownish-grey with a darker internal edge. Slight movement occurs between the halves of the apparatus.

The branchiæ commence as a short subulate process attached as a rule to the inner base of the dorsal cirrus of the fourth foot, though it may be the fifth in some—indeed, there is variation in this respect. About the eighth foot the branchia has three divisions and the same on the right tenth foot, the left having only two. The eleventh has three on one side and two on the other, whilst the twelfth has two on each side, but the right dorsal cirrus is bifid. The branchiæ behind generally have two divisions, occasionally three, then they diminish to one and cease at the fortieth foot, or occasionally there are rudimentary or simple processes to the forty-third or forty-fourth. The highest number of branchial filaments in each foot is four. In some young examples the highest is three. O. F. Müller describes his *E. pinnata* as having branchiæ from the seventh to the fortieth foot, and the pinnæ varying from six to eleven. Various abnormalities occur from injury and partial reproduction.

All the parts of the foot undergo diminution at the fortieth, only a minute branchial process being present on the base of the cirrus. The ventral cirrus is also less. The spines are either black, or, in young forms, of varying degrees of yellow or brown. As a rule they are gently tapered almost from the base to the tip, which is very slightly hooked —that is, curved backward and then forward. The tips are often abraded.

Posteriorly are the blackish hooks (Plate LXXXIII, fig. 9 *c*), the shafts of which have a more decided curve than the spines, the tip being bent backward and then forward as it diminishes to the neck. The great fang is short and stout, its inferior border forming more than a right angle with the neck, whilst the single short spike on the crown is

directed upward and slightly forward. The wings leave the neck a little above the point of diminution and are often injured distally. They are of varying degrees of yellow or brown in young specimens. There is little that is distinctive in these hooks in the group to which this species belongs.

The first foot has a long dorsal cirrus, and a considerable ventral cirrus—the two arising close together, so that but a small space remains for the two spines and the dorsal and ventral bristles. The dorsal cirri of the first five feet, indeed, are conspicuously longer, thereafter they diminish. The ventral cirri of five or six of the feet in the same region are likewise proportionally long.

At the tenth foot (Plate LXXIV, fig. 1) the dorsal cirrus is still proportionally long, and bears from its inner or dorsal base a single branchial process not half its length. Occasionally there are two. The setigerous region is bluntly conical, and is supported by two strong black spines (pale in young specimens). Superiorly are long simple bristles (Plate LXXXIII, fig. 9) and a series of brush-like forms (Plate LXXXIII, fig. 9 *a*), while ventrally are the compound (Plate LXXXIII, fig. 9 *b*) or falcate bristles.

At the twentieth foot the chief distinctions are the diminution in the dorsal cirrus, the branchia being bifid (or it may be trifid), and the increase in the depth of the dorsal cirrus, which has a thick cushion-like aspect.

In the examples brought from Norway by Canon Norman the tenth foot (Plate LXXIV, fig. 11) has a branchia with four divisions. Twentieth foot (Plate LXXIV, fig. 11*a*) has six divisions to the branchia. The falcate bristles of these are represented in Plate LXXXIII, fig. 8, and a posterior hook in Plate LXXXIII, fig. 8 *a*. Teeth and mandibles of this form are shown in Plate LXIII, figs. 4 and 4 *a*.

In a series of small examples dredged by Canon Norman in shell-gravel in Norway the branchiæ commence on the third foot. On the eighth foot the process is still simple. The twelfth foot has four divisions, whilst the twentieth (Plate LXXIV, fig. 11*a*) has six or seven. At the thirtieth foot are five, and at the thirty-ninth (last) a simple process. The maximum number of filaments of the branchiæ is nine or ten. They form tubes amongst the shell gravel. Considerable variation, indeed, is present. The dental apparatus of this small variety appears to agree with the type.

In a form of medium size in a very imperfect state of preservation, dredged in the 'Porcupine' Expedition of 1870 at a depth of 539 fathoms in grey mud, certain features diverge from the type above mentioned. Amongst these are the occurrence of black spines, the comparatively feeble development of the branchiæ, and the slight articulations of the dorsal cirri. On the tenth foot the bifid branchia is little more than a third the length of the dorsal cirrus, and it is slightly shorter at the twentieth foot, one of the divisions being rudimentary. A single short filament only occurs on the thirtieth foot, and it disappears before the fortieth. This form does not appear to lean either to the *Eunice torquata* of De Quatrefages or other type, and may require separation. The material in hand, however, does not warrant this step.

On the third foot of an example a long process projected from the posterior aspect of the setigerous region—evidently an abnormal papilla of the cutaneous tissues.

Food.—In the intestine of examples from Norway were vast numbers of spicules

of Gorgonidæ, fragments of Crustacea, and fragments of shelly tubes of Serpulids (*Hydroides*).

Habits.—O. F. Müller mentions the occurrence of this species in "Madreporæ," and more recently Marenzeller observes that this species, like *E. floridana*, Pourtales, inhabits coral-stocks of *Lophohelia prolifera* and *Amphihelia oculata*. Such appears to be the habit of certain Eunicids in all seas, the worms, as Dr. Alcock tells us, for instance in the stocks of *Lophohelia investigatoris* in the Indian Ocean, living in "tunnels formed by a crust of scleroderm that connected two neighbouring branches."[1]

Reproduction.—Those obtained in Norway by Canon Norman were loaded with ova and sperms in July.

In the 'Encycl. Méth.' (1827) *Leodice pinnata*, Lamk., is shown with few divisions to the branchiæ, whilst *Leodice norvegica* (idem, Vers, i, p. 134, Plate LVI, figs. 5—7) has a larger number of divisions in the branchiæ (six or seven), and the dorsal cirrus is larger.

O. F. Müller (1788) distinguished his *N. pennata* from *N. pinnata* by the presence of whitish globules (ova ?) above and below the intestine, and by the pennate instead of pinnate branchiæ, which arise in the former on feet seven to forty, and in the latter from feet five to twenty-six. Moreover, he figures the former with a dark speck at the base of the dorsal cirrus, and a median line of dark specks along the dorsum.

Œrsted considered that the branchiæ of the male *E. norvegica* were less divided (from three to five pinnæ) than those of the female, which had eight pinnæ on the branchiæ, and he thus made *E. pinnata* of O. F. Müller the male, and *E. pennata* the female of the species. In this connection Grube[2] observes that a female example with ova showed from seven to thirteen processes in the branchiæ, whilst one with minute eggs had four divisions.

Dr. Johnston's description (1865) has been held as pertaining to this species, though he states that he had not seen a specimen. The origin of the branchiæ on the seventh segment and the occurrence of from three to thirteen filaments in the branchiæ are differences. What the same author's *E. antennata* may be is uncertain.

Tauber places *Eunice fasciata* under this species, but he gives no definite reasons. In *E. fasciata*, however, the branchiæ continue to the end of the body, whereas in *E. norvegica* they cease at the fortieth foot.

4. EUNICE FLORIDANA, *Pourtales*, 1869. Plate LXV, figs. 7–7 *b*—head and teeth; Plate LXXV, figs. 2 and 2 *a*—feet; Plate LXXXIII, figs. 10–10 *b*—bristles.

Specific Characters.—Head with the palps grooved dorsally. Eyes behind the cirrophore of the frontal (external) tentacle and exterior to the lateral tentacles. Median tentacle as long as first ten or eleven segments. Tentacles slightly annulated. No other process is so. Tentacular cirri stretching beyond the palps. Body of 110 to 150 or more

[1] 'Zoological Gleanings,' 1901, p. 42, 1901.

[2] 'Schles. Gesellsch.,' 20th June, 1877 (1878), p. 16 (sep. abdr.).

segments and from 120 to 190 mm. in length, of a pale rose colour dorsally, pale iridescent ventrally. Two small anal cirri. Spines generally black throughout. Spatulate bristles with a long filament on one edge. Compound, with stout terminal piece, and bifid. Hook commencing about the thirtieth segment, and it is also black. Great dental plates with five or six teeth. Azygos plate, five to six teeth; anterior plates, four to eight teeth on left, eight to ten on right. Posterior process of apparatus one third length of maxillæ. V and VI anteriorly have each a tooth. Branchiæ commence on the seventh foot and continue almost to the tip of the tail. The divisions generally do not exceed four, but sometimes six to eight occur, and there are for the most part three anteriorly. Inhabits parchment-like tubes often on *Lophohelia* and *Amphihelia*.

Synonyms.

1863–69. *Marphysa florideana*, Pourtales. Bull. Mus. Comp. Zool., vol. i, p. 108.
1887. *Eunice floridana*, Ehlers. Mem. Mus. Comp. Zool., xv, p. 88, pl. xxii, f. 1—7.
1893. „ *philocorallia*, F. Buchanan. Proc. R. Dubl. Soc., vol. viii, p. 173, pl. ix, f. 2—6; pl. x, f. 7—9; and pl. xi.
„ „ *floridana*, Marenzeller. Zool. Ergebn., xii, Polych. Grund., p. 7, Taf. ii, f. 5.
1895. „ *florideana*, Pruvot and Racovitza. Arch. Zool. expér., 3e sér., t. iii, p. 395, pl. xvii, f. 59—62; pl. xviii, f. 62.
„ „ *amphihelii*, Roule. Camp. 'Caudan,' p. 447, pls. xix, xx, xxiii, and xxv, f. 1—3, 16—26.
1903. „ *philocorallia*, McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 559.
„ „ „ idem. Ibid., ser. 7, vol. xii, p. 140.
„ „ *amphiheliæ*, idem. Ibid., p. 164.

Habitat.—Large examples dredged in the 'Porcupine' Expedition of 1869 in 173 fathoms between Galway and the Porcupine Bank. Amongst colonies of *Lophohelia prolifera* at a depth of 200 fathoms, 50 miles off Bolus Head, Kerry (F. Buchanan).

Sand Key, Florida, in 100 fathoms (Pourtales). Gulf of Gasgoine (Marion and Roule). South of Cap St. Maira di Leuca (Marenzeller). Norway (Norman).

Head (Plate LXV, fig. 7) with the palpi separated by a notch in front and with a deep hollow dorsally anterior to each frontal tentacle. These are about the diameter of the head in spirit, and retain their crenations. They are little tapered in several examples, but in one in which the left had been reproduced it was as subulate as a dorsal cirrus. Behind these are the longer median and two lateral tentacles, the cirrophore of the former being just posterior to the line from the notch between the palpi, whilst the latter tentacles are slightly in front at each side. All bear traces of crenations. Behind the frontal and exterior to the lateral tentacle is the eye, which is of moderate size.

Body 6—8 ins. long and about 4 mm. broad in front, very little tapered anteriorly, but posteriorly diminishing to a slender tail with two cirri. Segments 100—150. First segment about as broad as the three following, with a deep notch laterally opposite the palpi, and a crenate border inferiorly. The second segment is shorter than the third and bears the tentacular cirri, which vary in length, but often extend beyond the frontal border of the first segment, and, Miss Buchanan observes, even beyond the palpi.

The armature of the proboscis (Plate LXV, figs. 7 *a* and 7 *b*) corresponds with the description of Marenzeller. The posterior appendages of the maxillæ are lobate. The

maxillary plates (II) have six teeth on the right, five on the left. The paired plates (IV) have nine or ten on the right, seven or eight on the left; unpaired (III) five teeth. The two anterior (V and VI) have each a tooth. In small forms, as this author observes, the teeth are fewer. The mandibles (Plate LXV, fig. 7 *b*) have expanded anterior plates and long tapering shafts.

In transverse section (Fig. 85) the great muscularity of the species is noteworthy, and the dorsal longitudinal muscles are specially large. A large neural canal exists inferiorly.

The typical foot (Plate LXXV, fig. 2) has an unjointed dorsal cirrus, which from the seventh foot onward to the tip of the tail carries a branchia. The first branchia has one, two, or three divisions, and as a rule the maximum number (which Marenzeller locates from the sixteenth to the eighteenth) is four. The branchiæ are less developed in small forms (Plate LXXV, fig. 2 *a*). While, however, the foregoing description applies to many examples, it does not suffice for all. Thus some well-developed specimens show greater freedom in the branches of the branchiæ, a feature exemplified even in the first, which in

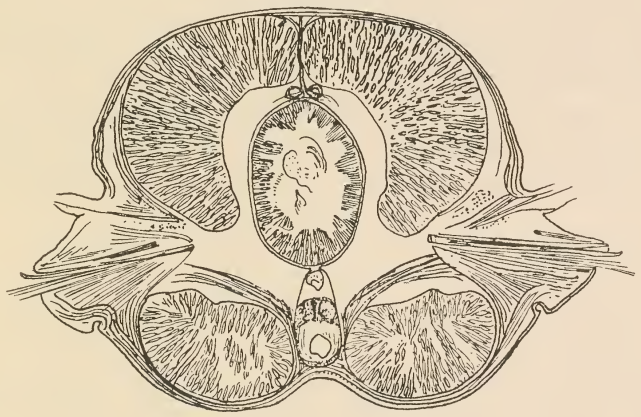


Fig. 85.—Transverse section of the anterior third of *Eunice floridana*. The dorsal longitudinal muscles are of great size.

one had been mutilated, and from the stump sprang a short tuft of six filaments. The second, however, had only two of the usual aspect, but they rapidly increased, so that the tenth foot had six, and some of the succeeding had seven filaments and possibly one or two more might have been found in others, for Ehlers[1] figures nine. No apparent difference could be detected in the branchiæ of the two sexes.

The setigerous region is supported by two powerful black spines, the tips of which generally pierce the skin. The dorsal bristles (Plate LXXXIII, fig. 10 *c*) are simple, with finely tapered tips and narrow wings. The brush-shaped forms (Plate LXXXIII, fig. 10) have a long process at one side. The compound (falcate) bristles (Plate LXXXIII, fig. 10 *a*) are yellowish, dilated toward the distal end of the shaft, which is bevelled and has internal striations. The terminal piece is somewhat short, with a bifid tip, and winged. The ventral hooks (Plate LXXXIII, fig. 10 *b*) appear about the thirty-first foot and continue to the posterior end. At first they are single, but by-and-by two project, and this till near the tip of the tail, when again a single hook occurs. The greater part of the hook is black, the proximal and distal ends alone being yellow. The tip has a strong fang at

[1] 'Florida Annel.,' pl. xxii, fig. 4.

right angles to the shaft, and a smaller hook on the crown. The commencement of the wing is indicated by a constriction in front.

In front the ventral cirri are bulbous inferiorly—with a conical tip, but posteriorly they are more elongate. The foot, indeed, in the posterior region of the body is somewhat more prominent, the spines are proportionally stronger, and the bristles more slender and longer.

Pourtales gave no tentacular cirri in his original description, but such appears to have been due to a misapprehension. He found it inhabiting "large deformed, paper-like tubes, with lateral openings irregularly placed, though in general alternate, bordered by laciniate and fimbriate flaps." He described the branchiæ as five- to seven-lobed, and stated that they began on the seventh or ninth ring.

Miss Buchanan (1893) was right in pointing out the close resemblance of her *Eunice philocorallia* to *E. floridana* of Pourtales and Ehlers, the differences mentioned, however, being only variations.

Marenzeller's account (1893) is both minute and careful. He figures a calcareous tube with terminal and lateral openings attached to *Lophohelia prolifera*, and he also found it on *Lophohelia oculata* in the Museum at Vienna.

Roule (1896) does not allude to Miss Buchanan's species, and considers that *E. amphiheliæ* most nearly approaches *E. fasciata*. He mentions that a note about this form was first published by Filhol in "La Vie au fond des mers," 'Bibliothèque de la Nature' (Paris, Masson).

Genus LXXI.—MARPHYSA, *De Quatrefages*, 1865.

Head bilobed or rounded, with massive palpi. No tentacular cirri. Body typical, terminating posteriorly in two cirri. Maxillæ as in *Eunice*, but with a tendency to elongation of the posterior processes. An azygos plate on the left. Foot with a dorsal and a ventral cirrus. Knife-shaped bristles superiorly, compound falcate inferiorly. Strong bifid hooks occur in the ventral region posteriorly.

Ehlers (1868) characterized the genus as having five tentacles and a pair of massive palpi. No tentacular cirri on the second of the two footless segments. Foot with a dorsal and a ventral cirrus, dorsally with simple knife-shaped bristles, and ventrally with compound bristles. Branchiæ simple or with a short stem from which project filaments more or less elongate. Four anal cirri. Upper jaw with teeth and fang; an additional plate in the left row of teeth.

1. MARPHYSA SANGUINEA, *Montagu*, 1807. Plate LIV, fig. 2; Plate LXIII, figs. 1 and 1 *a*—teeth; Plate LXV, fig. 14—foot; Plate LXXIV, figs. 8 and 8 *a*—feet; Plate LXXXIII, figs. 5–5 *b*—bristles.

Specific Characters.—Head deeply bilobed, flattened, with five dull yellow and rather long tentacles, which are slightly wrinkled. Eyes normal in position. Body 18 ins. to 2 ft. long, rounded in extension, flattened in contraction, terminating posteriorly in two cirri. Colour ash-grey or greenish brown, duskier in front, paler posteriorly, with fine irides-

cence. Dorsum minutely dotted anteriorly. Maxillæ with a flattened curve and a strong hook in front. A flange posteriorly indents the great dental plate, which on the left has three teeth in front, and on the right four. The anterior crescentic plate on the right has seven to eight teeth, the left five to six. The azygos plate on the left has six to seven small teeth. The spathulate posterior appendages are dark brown, the ends of the maxillæ being pointed and pale chocolate brown. The mandibles have a dense porcellanous plate ventrally, the front edge being bevelled to a blunt point externally and having a black spot, whilst the limbs taper posteriorly and are marked by longitudinal lines. The foot presents considerable changes in its progress from before backward, the dorsal cirrus increasing in bulk, and the superior lobe increasing in depth. At the tenth foot the superior lobe in profile is broadly conical, the posterior flap projecting superiorly and sloping inward inferiorly. The branchiæ commence about the twenty-first foot, and continue till within twelve to fifteen segments of the tip of the tail.

Synonyms.

1807. *Nereis sanguinea,* Montagu. Trans. Linn. Soc., xi, p. 26, pl. 3, f. 1.
1818. *Leodice* „ Lamarck. Anim. sans Vert., v, p. 323; 2nd edit., v, p. 563.
1820. „ *opalina,* Savigny. Syst. des Annel., p. 51.
1828. *Nereidonta sanguinea,* De Blainville. Dict. Sc. Nat., Art. Vers., t. lvii, p. 477, and Atlas, pl. 15, f. 2.
„ *Leodice sanguinea,* Stark. Elements, ii, p. 137.
„ *Eunice* „ Fleming. Encycl. Brit., 7th edit., xi, p. 219.
1833. „ „ Audouin and Edwards. Ann. Sc. nat., t. xxviii, p. 220.
1834. „ „ idem. Annél. Litt. de la France, p. 147.
1836. „ „ Cuvier. Règne Anim., t. iii, p. 200.
1838. „ „ (circulation), H. M. Edwards. Ann. Sc. nat., 2e sér., p. 204, pl. 12, f. 2.
1851. „ *sanguinea,* Grube. Fam. der Annel., pp. 44 and 123.
1853. „ „ Leidy. Proc. Acad. Nat. Sc. Philad., p. 147.
1864. „ „ Grube. Insel Lussin, p. 79.
1865. „ „ Johnston. Cat. Worms Brit. Mus., pp. 134 and 340.
„ *Marphysa* „ De Quatrefages. Annel., i, p. 332.
„ „ *Leidii,* idem. Ibid., i, p. 337.
1867. *Eunice sanguinea,* Parfitt. Trans. Devon. Assoc., ii, p. 20 (sep. copy).
1868. „ „ Ehlers. Borstenw., ii, p. 360, Taf. xvi, f. 8—11.
1870. *Marphysa* „ Baird. Journ. Linn. Soc., vol. x, p. 352.
„ „ „ Grube. Arch. f. Naturges., Bd. xxxvi, p. 298.
1873. „ *Leidyi,* Verrill. Invert. Viny. Sound, U. S. Comm. F. and F., p. 593.
1875. „ *sanguinea,* Marion and Bobretzky. Ann. Sc. nat., 6e sér., t. ii, p. 12.
1879. „ „ Webster. Trans. Albany Inst., ix, p. 36.
„ „ „ idem. 32nd Report N. York State Museum, p. 115.
1885. „ „ Carus. Fauna Medit., p. 212.
1887. „ „ Ehlers. Florida Annel., p. 97.
1888. „ „ De St. Joseph. Ann. Sc. nat., 7e sér., t. v, p. 201.
1890. „ „ Malaquin. Annél. Boulon, p. 24 (Rev. Biol. Nord. Fr., t. ii, pp. 176 and 179).
1892. „ „ (eyes), Andrews. Journ. Morph., p. 180, pl. xi, f. 34, 35, 38, etc.
1901. „ „ Fauvel. Bull. Soc. Linn. Normand., 5e sér., vol. v, p. 61.
1903. „ „ McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 559.

1903. *Marphysa sanguinea*, McIntosh. Mar. Invert. S. Africa, vol. iii, p. 44.
1904. „ „ Allen. Journ. M. B. A., N.S., vii, p. 225.
1905. „ „ Graeffe. Arbeit. Zool. Stat. Triest., xv, p. 321.
1906. „ „ Bohn. Ann. Sc. nat., 9e sér., t. iii, p. 101.

Habitat.—Abundant at St. Peter Port, Perelle Bay, and other parts of Guernsey, and in similar places in Herm and the Gouliot Caves, Sark (W. C. M.). Polperro, Cornwall, on a gravelly bottom (Laughrin). Coast of Devon (Montagu).

Mediterranean. Adriatic (Graeffe). American coast (Leidy). Shores of France (De Quatrefages, etc.). Vinyard Sound, United States (Verrill). Virginian coast and New Jersey (Webster). South Africa (W. C. M.). Angra Pequena (Marenzeller).

Head deeply bilobed and somewhat flattened. It bears five smooth dull yellow tentacles of considerable length, the median being posterior and somewhat longer than the others. The two lateral arise obliquely, one in front of the other a little externally and in front of the median. The tentacles generally present slight wrinkles. A single eye on each side lies behind the outer tentacle and to the exterior of the inner. The large flattened palpi form a continuation of the head anteriorly.

Body 18 ins. to 2 ft. long, somewhat rounded in extension, flattened in contraction, slightly tapered anteriorly and finely tapered posteriorly to the tail, which ends in two cirri springing from the ventral edge of the anus, as in *Nereis*. The peristomial segment resembles in outline that of *Nereis pelagica*, though the dorsal and ventral wrinkles are characteristic. Behind the foregoing is a narrow segment without appendages, and those which follow are also narrow. In colour it is brilliantly iridescent, with a basis of ash-grey or greenish-brown, the iridescence being most marked anteriorly, where the duskier hue reflects the colours more conspicuously, so as to rival the sheen of tropical beetles. In large examples the body is darker in the middle from a slight development of pigment, gradually becoming pale posteriorly, especially toward the tip of the tail, which is often greenish. As in *Nereis*, the dorsum anteriorly is minutely dotted.

Proboscis.—The maxillæ (Plate LXIII, fig. 1) have a lateral flattening of the curve, and a strong hook in front. A flange posteriorly indents the maxillary plate, which has three teeth in front on the left and four on the right. The crescentic anterior plate on the right has seven or eight teeth, the corresponding one on the left having fewer (five to six), whilst the intermediate process on the left has six or seven small teeth. Some of the teeth in the three plates just mentioned are not distinct. The posterior spatulate plates are dark brown, the ends of the maxillæ being pointed and pale chocolate brown. The mandibles have a dense porcellanous plate ventrally in front (Plate LXIII, fig. 1 *a*), with a black touch externally. The front edge is bevelled to a blunt point. The shafts taper posteriorly, and are marked by longitudinal lines.

The first foot has a slightly conical short dorsal cirrus which does not extend so far outward as the upper lobe, the base of which is broad and the tip acutely conical, whilst three black spines pass into it, with a tuft of simple (dorsal) bristles which project above the lobe. The ventral lobe is shorter and broadly lanceolate. In the second foot the dorsal cirrus extends beyond the superior lobe, and another tuft of bristles (jointed) projects from that inferiorly. In the anterior feet the dorsal cirrus is large and vascular.

In its progress backward the foot undergoes considerable change, the dorsal cirrus increasing in bulk whilst the superior lobe increases in depth and thickness and develops a posterior flap which is prominent superiorly. At the tenth foot, for example (Plate LXXIV, fig. 8 *a*), a posterior view shows a broadly conical superior lobe, the posterior flap projecting superiorly and sloping inward inferiorly, the tuft of simple dorsal bristles slanting upward and outward above the spines, whilst the inferior jointed bristles project below it. The ventral lobe is conical with a long line (margin) inferiorly, corresponding to the bulbous border.

About the twenty-first foot, sometimes a little in front, a clavate process appears at the inner base of the dorsal cirrus, the first indication of the branchiæ, which thus pertain to the dorsal cirrus. In an example in which these organs began on the twenty-first foot, the twenty-second had a simple but longer process. On the twenty-third the increasing process had a short spur on its inner side. Both processes had considerably increased in length on the twenty-fourth foot. The twenty-fifth and twenty-sixth had each two divisions springing from a common base, and so had the twenty-seventh on the left, but the right branchia of the twenty-seventh had a stem with three divisions (Plate LXXIV, fig. 8). Four divisions characterized the thirty-second foot, and the processes were longer. Five divisions soon make their appearance, and about the fiftieth foot there are six (in the large example taken as the type), and these form a pectinate series which project upward from a more or less horizontal stem, the longest being to the exterior, the shortest to the interior. This condition, however, may arise from the last formed process budding from the base of that adjoining, and becoming continuous with the oblique stem. The basal trunk from which all these arise is stout.

Behind the foregoing the maximum number of branches is found, viz. eight, and as the processes are long and bright red, they form a conspicuous series along the dorsum. After attaining the maximum the branchiæ gradually diminish in number, and by-and-by in size, until in front of the tail a short process of two divisions and then of one occurs, the last twelve to fifteen segments or thereabout being devoid of them. Probably the condition as regards reproduction of the tail has much to do with the arrangement in individual specimens. In sickly and dying forms the branchiæ become pale.

An urn-shaped Infusorian (somewhat like *Biosæca*) occurred in great numbers on the branchiæ.

The dorsal bristles, which leave the foot above the spines, have anteriorly translucent slender straight shafts, the terminal region being marked from these by a slight curve, beyond which the tip appears to be flattened, is a little dilated, and then tapers to a fine point. In the middle of the body the curve alluded to is more gentle (Plate LXXXIII, figs. 5 and 5 *a*, and also Plate LXXVII, fig. 16), and the dilatation of the tip more distinct. The edge is also very finely serrated. Amongst the foregoing is a group of brush-shaped bristles (Plate LXXXIII, fig. 5 *a*), the distal margin being of considerable breadth and with a series of fine teeth, the edge at each side having a longer process. A few of these appear on the tenth foot and continue to the posterior end, where (just in front of the tail) they increase in size and some have considerably coarser fimbriæ (Plate LXXXIII, fig. 5 *b*) which are also oblique.

In the inferior group of bristles the shaft is curved toward the tip, dilated and

bevelled, whilst it is also marked by distinct striæ, which slope obliquely from the serrated anterior edge downward and backward (Plate LXXXIII, fig. 5 *c*). The distal piece is articulated in the usual manner—broad at the base and tapered to a fine point. A few fine striæ slope obliquely downward and backward from the edge.

Three black spines occur in front, but at the fiftieth foot two are found. At the ninetieth foot only a single black spine is present, and this remains to the posterior end. At the fiftieth foot, however, a pale brown spine passes at an angle from the black spine, and projects at the inferior edge of the setigerous process, a little above the ventral lobe. At the ninetieth (Plate LXV, fig. 14) a brown spine accompanies the black, and two project inferiorly, the tips of these having wings. In the terminal segments one or two black spines are present, and the oblique brown bristle has the two terminal wings and is bifid at the tip.

Habits.—These animals lurk in their long galleries in cracks and in fissures of rocks at and near low water-mark, the crevices usually being filled up with dark mud or muddy sand and gravel, in which their tunnels are formed. They also occur under large stones lying on a sandy bottom, the posterior end of the tunnel penetrating deeply into the sand, so that when the stone is raised they disappear into the tube and require a considerable amount of digging to secure them, and even then only fragments may be obtained. The gallery in fissures of rocks is sometimes in the form of a siphon, and is frequently more than 18 ins. long. Thus the tail as well as the head of the annelid can readily be bathed by the advancing tide. They do not appear to care for constant immersion, and their galleries, though sheltered, are sometimes barely moist.

When disturbed by splitting the rocks it withdraws the end of the body exposed, and clings tenaciously to its tunnel. If an attempt be made to draw it out by the anterior end rupture readily ensues, and however skilful the collector may be the majority of the specimens are more or less mutilated. When both ends of the tunnel are exposed it withdraws itself to the most distant part. In several instances at St. Peter Port, Guernsey, and also at Polperro, Cornwall, the little commensal, *Harmothoë marphysæ*, McI., accompanies *Marphysa* in its galleries.[1]

On the whole it is somewhat sluggish in its tube, but when placed freely in a vessel of sea-water it wriggles actively, making a series of screw-like coils after the manner of *Eteone*.

This annelid is used as bait by the fishermen of St. Peter Port and the Channel Islands generally under the term "Varme," being highly prized as a tempting bait for the capture of whiting pout, wrasses, and other ordinary fishes as well as dog-fishes. The men search for them with spades at low water, and they are plentiful on an oyster-bed to the north of the pier at St. Peter Port. If the tube passes straight into the muddy sand few entire examples are procured, but if a bed of rock lies beneath seven or eight inches of sand they are often captured entire. Three or four inches of the anterior end of the worms are placed in vessels amongst a little black or decaying "wrack," and they can thus be kept about a fortnight. If the rest of the body were retained, the worms would quickly break into fragments and putrefy.

A large example was conveyed from Herm to Norwich in August, but the great

[1] 'Monogr. Brit. Annel.,' vol. i, p. 339.

heat and close quarters in that town proved fatal. Others, however, have been sent alive from Jersey to St. Andrews, and survived a considerable time. Although fragments of shells have been found near their galleries, it is probable these were due to other animals. The species seems to be phytivorous.

This is one of the many additions made to the British Fauna by the acute and indefatigable Colonel Montagu (1807), who searched the tidal region of the South Devonshire coast with such perseverance and success, and whose figures by his niece, Miss Dorville, are so useful to his successors. He observes that it is the largest "Nereis" yet discovered on the British shores, extending sometimes to fifteen inches, and frequenting rocky situations. The much larger *Nereis virens*, Sars, had not then been described.

This does not appear to be the *Eunice sanguinea* of Delle Chiaje,[1] either in regard to structure or coloration, though tentacular cirri are also absent in it.

Milne Edwards, in one of his early papers,[2] gives a general account of the circulation of this form, and compares it with the condition in *Terebella*.

A paper was published by H. Koch[3] on the so-called development (viviparous) of *Marphysa sanguinea*, but the figures and descriptions show that the author had before him a parasitic Lumbriconereid such as *Oligobranchus*, or perhaps, as Ehlers states, Nematodes.

This form is prominently used by De Quatrefages (1865) in his description of the anatomy of annelids—for he considered that its structure was both complicated and superior to that of most of the Errant Annelids. Moreover, he credited it with a single otocyst in the buccal segment, but Fauvel,[4] who has not actually found otocysts in any of the Eunicidæ, thinks a misapprehension had occurred. De Quatrefages separated the American examples under the name *Marphysa Leidii*, but this appears to be unnecessary. He also observed (1844) that an example appeared, from its coloration, to have regenerated the head and adjoining segments.

Ehlers (1868) had only an incomplete spirit-specimen for description, but his account is on the whole good, though he misinterpreted the condition of the segmental organs. He pointed out Koch's error in supposing that this species was viviparous, the appearances having been due to parasitic Nematodes.

Marion and Bobretzky (1875) observe that the fishermen of Marseilles employ this form for bait under the name of *Mouréda*, and they mention the occurrence of examples with simple branchiæ throughout.

Webster found *Marphysa sanguinea* in great abundance on the Virginian coast and at various stages from 2·5 mm. to 20 cm. in length. The youngest had eighteen to twenty-two feet, no tentacles, no branchiæ, and no indication of frontal lobes. It had bidentate setæ in the anterior segments. There are five eye-specks. In the next stage (2·5 to 4 mm.) one tentacle is present, bidentate setæ have disappeared from two or three of the anterior segments, and there is a slight depression of the anterior margin of the head. When

[1] 'Descrizione,' iii, p. 104, etc., Tav. 103, f. 9, 10, etc.

[2] 'Ann. Sc. nat.,' 2e sér., t. x, p. 204, 1838.

[3] 'Noveaux Mém. de la Soc. helvétique,' viii, p. 1, Taf. i and ii, 1845.

[4] 'Ann. Sc. nat.,' 9e sér., t. vi, pp. 4—7, 1907.

4 mm. long, simple branchiæ appear on the tenth setigerous segment. In the larger examples (10 to 20 mm.) the eyes are always two, and the branchiæ commence on any segment between the tenth and twenty-third (as in the adult), and they are usually bifurcate. The dental apparatus of these, according to the author, agrees with that in the adult. The brush-shaped bristles do not occur in the youngest forms, or until three tentacles and branchiæ are present. If the author is accurate in his diagnosis, the younger forms resemble *Nematonereis*. The same author mentions that in those from New Jersey the branchiæ commence on the tenth foot—a considerable variation from the usual condition in Britain.

Cosmovici[1] describes the segmental organs of this species as consisting of a ciliated funnel in the dissepiment in front, and a tube leading externally at the base of the foot.

Mr. Borradaile[2] gives an interesting account of the early stages in the development of a Ceylonese *Marphysa*. The yellowish eggs are in an oval mass of mucus with a stalk, and he found that the larvæ, after escaping from this, afterwards secreted another mucus investment in which they lived gregariously.

Benham states that it is the "rock-worm" of the Channel Islands.

Gravier[3] (1909) describes an instance of reproduction of head and anterior segments and tail in an example of this species from St. Vaast-la-Hougue. The tapered anterior end is conspicuous.

2. Marphysa Belli, *Audouin and Edwards*, 1833. Plate LV, fig. 5; Plate LV, fig. 6—foot; Plate LX, fig. 12—head; Plate LXIII, figs. 2 and 2 *a*—teeth; Plate LXV, figs. 11 and 11 *a*—teeth; Plate LXXXVI, figs. 3 and 3 *d*—bristles.

Specific Characters.—Head bluntly conical, with a median groove inferiorly, but evenly rounded in front, only a slight notch appearing in spirit. Tentacles proportionally long and slightly crenate. Body 6—7 ins. long, and attenuated for a Eunicid. It is somewhat reddish anteriorly, fawn coloured posteriorly, with a dark purple central streak from the blood-vessel. It is highly iridescent throughout. Peristomial segment twice the breadth of the others, that following being about the average breadth. Proboscis, armed with maxillæ which rise little above the horizontal, are blackish-brown anteriorly and greyish or pale chocolate at the base. Basal processes foot-shaped with a terminal point. Great dental plates have seven teeth, the azygos plate on the left has seven or eight teeth, the curved plate in front about six teeth. The right anterior curved plate has seven to eight teeth. The mandibles have black tapering shafts, and the cutting anterior edges are sinuous. Branchiæ commence on the fourteenth foot and continue to the thirty-fourth or a little further, and thus range from twenty to twenty-five in number. The central stems have most filaments, the first having about ten, the twenty-eighth

[1] 'Thesis,' p. 114, pl. xxvi, fig. 7.
[2] 'Proc. Zool. Soc.,' 1901, vol. ii, p. 714, pl. xxxix.
[3] 'Ann. Sc. nat.,' 9e sér., t. ix, p. 150, 1 text-fig.

nineteen divisions, and the last about thirteen. Foot with a short dorsal cirrus in front, more elongated in the branchial region and posteriorly, a short bluntly conical setigerous region with two or three blackish-brown spines in front, and bristles of three kinds, viz., simple tapering dorsal bristles, compound falcate bristles with narrow terminal pieces which are bifid and winged, and thirdly, a few compound forms with tapering terminal pieces as in *Marphysa sanguinea*. This type of foot extends to the end of the branchial region. The posterior foot has also the three kinds of bristles—considerably diminished posteriorly—but has, in addition to the black spine, one or two long, bifid winged hooks (modifications of spines) which slightly slant downward.

Synonyms.

1833. *Eunice Bellii*, Audouin and Edwards. Ann. Sc. nat., 1e sér., t. xxvii, pl. ii, f. 1—4, 8, 9 ; t. xxviii, p. 223.
1834. „ „ idem. Annél., p. 149, pl. iii, f. 1—4, 8, and 9.
1836—7. *Eunice Belli*, idem. Cuvier, Règne Anim., 2e ed., iii, p. 200 (note).
1851. *Eunice Bellii*, Grube. Fam. Annel., pp. 44, 123.
1865. *Marphysa Belli*, De Quatrefages. Annel., i, p. 333.
1869. „ „ Grube. Mitth. St. Vaast-la-Hougue, p. 36.
1874. „ *Bellii*, Marenzeller. Adriat. Annel., p. 59.
1885. „ „ Carus. Fauna Medit., p. 213.
1887. „ „ Ehlers. Florida Annel., p. 95, Taf. xxviii, f. 1—8.
1902. „ „ Marenzeller. Polychæt. des Grundes (Kaiserlichen Akad.), p. 17.
1903. „ „ McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 560.
1904. „ „ Allen. Journ. M. B. A., n.s., vii, p. 225.
1905. „ „ Graeffe. Arbeit. Zool. Stat. Triest, xv, p. 321.

Habitat.—Under a stone near low water-mark of ordinary tide near the boatman's house, Herm (1868). Plymouth (Allen).

Shores of France. Mediterranean. American shores (Ehlers).

LV

Head (Plate LX, fig. 12) bluntly conical, evenly rounded in front, with scarcely a trace of a notch dorsally, but with a well-marked ventral median groove—probably indicating the palpi. The median and two lateral tentacles are proportionally long and slightly crenate, the median exceeding the others in length. A small eye lies at the base of the inner lateral tentacle—externally. The mouth presents a median frill at the posterior end of the groove of the snout and a prominent and rounded posterior lip. The peristomial segment is twice the breadth of the others, the footless segment succeeding it being of the normal breadth. At its ventral edge it is somewhat coarsely crenate.

Body 6—7 ins. long—attenuated for a Eunicid, so that at first sight it resembles *Lumbriconereis*; slightly tapered towards the head, and ending in a slender tail. It is somewhat reddish anteriorly and highly iridescent throughout. Behind the branchiæ is a dark purple central streak from the blood-vessel, the rest being iridescent fawn-colour.

The maxillæ (Plate LXV, fig. 11) are greyish or pale chocolate at the base, the curved fang anteriorly being blackish brown. A dark line separates them from the basal processes, which are somewhat elongate, the outer border sloping inward, then forming an elevation, and lastly curving to a slipper-shaped tip. The tips and inner edges are dark,

According to Macintosh, the Compound spiniger exist throughout the whole segment of Marphysa Belli.
P. 449 — 451.

whilst a greyish area occurs anteriorly next the latter. A small process projects from each posteriorly. The great dental plates have seven teeth; the azygos plate on the left has seven or eight teeth; the curved plate in front about six teeth; the right anterior curved plate seven or eight teeth. The mandibles (Plate LXV, fig. 11 *a*) have black tapering shafts and the cutting anterior edges are sinuous.

The branchiæ commence on the fourteenth foot as a process of ten divisions, all of considerable length, and arising from the outer border of the main stem, the tip of which makes the tenth filament. Sixteen divisions occur on the twentieth foot, nineteen on the twenty-eighth, and thirteen on the last. The filaments are therefore much more numerous than indicated by De Quatrefages, provided the forms are the same, for he gives six to eight as the number of divisions. The total number of branchiæ on each side varies from twenty to twenty-five. When the body is stretched the beautiful red branchiæ glide alternately, each passing to the opposite side, the right being anterior. In contraction they form a dense group.

The first foot has a short dorsal cirrus, shaped somewhat like an awl-handle—that is, constricted at the base, dilating, and again tapering towards the tip. The setigerous region is short and bluntly conical, and is supported by a single blackish spine, or by two or three. It carries four kinds of bristles, viz., dorsally simple tapering bristles, with faint traces of spikes on the edge, and a few brush-shaped forms with nearly equal lateral filaments (Plate LXXXVI, fig. 3 *b*), then a mixed group of jointed bristles, the majority having slightly curved shafts, dilated and bevelled at the tip, to which a rather narrow bifid terminal piece with wings is articulated, and lastly one or two of the type of *Marphysa sanguinea* with similar shafts, but with long tapering terminal pieces ending in a fine point. Behind the setigerous lobe is a slightly flattened conical flap, whilst inferiorly is a somewhat thick and broadly conical ventral cirrus.

The changes which the foot undergoes to the thirteenth consist chiefly in the increase of its various parts. Thus at the eighth foot (Plate LV, fig. 6) the dorsal cirrus is more elongate, the setigerous and the posterior lobes are more prominent, the bristles longer, and the ventral cirrus is longer. These features are still more pronounced at the thirteenth foot, in which the increase in size is considerable. The dorsal cirrus is now long and tapering, the setigerous region of greater depth, the posterior lobe broader (deeper) at the base, and more tapered at the tip, whilst the ventral cirrus or lobe has the shape of a broadly conical flap. The setigerous region is supported by three spines, and bears the elongated slender simple bristles superiorly (Plate LXXXVI, fig. 3), along with certain brush-shaped forms (Plate LXXXVI, fig. 3 *b*) which have long lateral filaments. Inferiorly are the compound falcate bristles (Plate LXXXVI, fig. 3 *a*), which are characterized by the slight curvature of the shaft and the dilatation of the end, which is spinous at the edges, and by the comparative narrowness of the terminal process, and lastly, those having similar shafts, but with long tapering terminal processes (Plate LXXXVI, fig. 3 *c*) after the manner of those of *Marphysa sanguinea*. The posterior lamella of the setigerous region is somewhat lanceolate in front. The ventral cirrus is rather short, massive, and conical.

The addition of the branchiæ is the only noteworthy change in the feet of the branchial region, two or three spines being present in the setigerous process. The post-

branchial feet, again, differ in so far as the lower of the two spines separates from the upper and is joined by a second, and their tips are differentiated into bifid winged hooks. Thus at the fortieth foot the main spine is blackish brown, and both the tips and the concavity are directed upward. A pale spine considerably less lies above it. The two bifid hooks have their convexity directed upward, and their tips project a short distance below the spine. The older is usually dark brown, and the younger pale brown, the tips in both being pale, bifid, and winged (Plate LXXXVI, fig. 3 *d*). The four kinds of bristles are still present, though their number appears to be fewer. This type of foot continues to the posterior end, as a rule one strong blackish brown spine and long bifid hook guarded by a wing being found in each setigerous process, with the three kinds of bristles—all, however, diminished in size. Both the posterior lamella and the ventral cirrus are more pointed posteriorly.

Habits.—In confinement in a vessel it keeps its body in screw coils amongst sand.

This is one of the many forms which the able authors[1] of the 'Annelids of the Coast of France' have added to the literature of the subject, and their description so far as it goes is good.

De Quatrefages[2] considered that he had found another species allied to this form at Chaussey, but the description does not appear to distinguish it from the earlier one. He omits notice of this form, moreover, in the '*Annelés.*' It may be, however, that the author thought that the description of Audouin and Edwards did not apply to a species with three kinds of bristles, besides the brush-shaped ones, in the anterior feet. He afterwards, perhaps, considered that the differences were due to defective descriptions.

Ehlers describes the branchiæ of the American forms as occurring on the fifteenth foot, and being fourteen pairs in number, whereas Marenzeller notes in the Adriatic forms that they commence on the twelfth, and that their number is from fifteen to twenty-five. Considerable variation is thus present.

3. MARPHYSA KINBERGI,[3] n. s. Plate LXXIV, figs. 9 and 9 *a*—feet and branchiæ; Plate LXXXIII, figs. 6–6 *b*—bristles.

Specific Characters.—Head bluntly conical, without a trace of a notch dorsally in spirit; ventrally a well-marked median groove; median and lateral tentacles of considerable length, the former the longer; no eyes visible in the preparations. Body small, scarcely $\frac{5}{8}$ in. in length, more massive in the preparation anteriorly than posteriorly. It is somewhat flattened anteriorly, rounded posteriorly, but is incomplete. The maxillæ are chocolate brown, with darker blades, which do not rise much above the horizontal. Posterior processes—to which they are articulated—are lobate. Great dental plates have six teeth, the anterior being long and recurved, and a considerable portion posteriorly being smooth. Azygos plate with seven teeth. Anterior curved plate on the right has six

[1] Audouin and Edwards, 'Annél.,' p. 149, pl. iii, figs. 1–4 and 8—9, 1834.

[2] 'Magasin de Zoologie,' An. 1843, p. 4, pl. ii, figs. 1, 2.

[3] Named after the late Prof. Kinberg, of Stockholm, who did much to advance our knowledge of the Marine Annelids.

teeth. Mandible with the oblique anterior edge smooth, the outer angle, however, being prominent. The branchiæ form an isolated tuft, commencing about the sixteenth and continuing to the thirty-sixth foot. The anterior gills have from five to nine filaments, those best developed twenty-four or twenty-five. The foot has a short subulate dorsal cirrus in front, but it becomes longer in its progress backward. The setigerous region bears longer dorsal bristles than in *Marphysa Belli*, and brush-shaped forms, whilst the inferior group is composed only of those with long tapering tips, as in *Marphysa sanguinea*. Posteriorly the dorsal bristles are longer, and the long bifid brown ventral hook projects inferiorly.

Habitat.—Dredged in the 'Porcupine' Expedition of 1870 nine miles off Cape Finisterre in eighty-one fathoms on a hard bottom with sandy mud. Though not procured in what are usually considered British waters, it has been thought proper to include this species here.

Proboscis.—The maxillæ are pale chocolate brown with darker blades which do not rise much above the horizontal. They are articulated posteriorly to two rather long lobate processes which are somewhat narrowed at the commencement. The great dental plates have six teeth, the anterior being long and recurved, and a considerable posterior region being smooth. The azygos plate on the left has about seven teeth. The anterior plate on the right has six teeth; that on the left has fewer. A dark horny patch also occurs in front on each side. The mandibles have the oblique anterior edge smooth, the outer angle, however, being prominent.

The branchiæ commence on the sixteenth foot, thus differing from *Marphysa Belli* from the Channel Islands. The initial filament occurs only on one side (the right). The seventeenth on the right has a considerable gill of nine filaments; that on the left five or six. They are present in all on twenty segments, the last having fewer filaments. The whole forms a somewhat isolated and dense tuft, some of the best developed (Plate LXXIV, fig. 9 *a*) having twenty-four or twenty-five filaments which are longest in the middle, and arise as usual from the side of the branchial stem.

At the tenth foot (Plate LXXIV, fig. 9) the dorsal cirrus is a proportionally large subulate process—somewhat constricted at the base. The setigerous region has a bluntly conical outline, with a conical lamella projecting beyond it. It is supported by three black spines. Dorsally it bears a dense group of translucent simple bristles, the tips of which have a very slight expansion and then taper to a fine point (Plate LXXXIII, fig. 6). Ventrally are the even more numerous jointed bristles (Plate LXXXIII, fig. 6 *a*), which have translucent shafts with dilated distal ends showing fine striæ, and serrations on the edge. The terminal piece forms a long tapering spear which diminishes in length from the upper bristles downward. Moreover, when fracture occurs near the attachment of the distal piece a portion remains at the socket, a condition not usually seen in such forms, and indicating a differentiation of the point of attachment (Plate LXXXIII, fig. 6 *b*). Each foot has a *rete mirabile* of branching blood-vessels.

The closeness in external resemblance between this species and *M. Belli*, Aud. and Edw., is interesting—associated as it is with the divergent structure of the bristles.

Genus LXXII.—Nematonereis, *Schmarda*, 1861.

Head smoothly rounded, with a single median tentacle. Body elongated and distinctly segmented; two segments devoid of feet. Upper dental apparatus with an uneven number of plates. The body-wall of *Nematonereis unicornis* is thick and muscular, after the type of the Eunicidæ and Lumbriconereidæ. The nerve-area is pyriform with the narrow end inferiorly—as a short pedicle. The area has a thick coating of cells which stain deeply. A small neural canal exists in the centre superiorly. The oblique muscles are attached to the upper and outer border, and some fibres pass down to the apex of the nerve-area. The hypoderm forms a thicker layer in the centre inferiorly, and the fibres of the circular coat curve inward along its inner border and apparently cross below the nerve-area. On the inner aspect of the area in certain parts is a coarsely granular brownish layer which does not stain well, and is probably fatty. Foot with dorsal and ventral cirri; simple bristles, with a few brush-shaped forms, dorsally; jointed hooks inferiorly.

Ehlers (1868), characterizes the genus as having a single tentacle; two segments devoid of feet. Foot with dorsal and ventral cirri, simple and compound bristles. Upper jaws with an uneven number of jaw-plates.

1. Nematonereis unicornis, *Grube*, 1840. Plate LIV, fig. 3; Plate LXIII, figs. 5 and 5 *a*—teeth; Plate LXXV, figs. 3 and 3 *a*—feet; Plate LXXXIV, figs. 1–1 *c*—bristles.

Specific Characters.—Head smoothly rounded in front; two large black eyes at its posterior border and between them a subulate median tentacle. Body five to six inches long, pale pinkish and iridescent in front, posteriorly cream-coloured with a pale orange streak from the intestine. The anterior of the first two segments is the broader. The body terminates posteriorly in four (Ehlers) anal cirri. Maxillæ short and strongly hooked anteriorly, their posterior appendages of an elongated conical outline. Anterior plates have a triangular brown patch in front. Great dental plates have four or five large teeth.[1] Mandibles hatchet-like, the expanded anterior blade with parallel lines. The vascular anterior feet (*e.g.*, tenth) have a subulate dorsal cirrus. The setigerous region has a single brown spine; above it two groups of winged bristles with attenuate tips. Below the spine are jointed hooks which have the dilated end of the shaft minutely serrate. Ventral cirrus pear-shaped. Behind the foregoing the dorsal cirrus by-and-by becomes more slender and has a distinct granular enlargement at its base. A single group of winged bristles with attenuate tips and a few brush-shaped forms occur above the spine, whilst the jointed bristles beneath are stronger. The whole setigerous region is proportionally less, but it is more prominent. A single powerful hook projects above the ventral cirrus from the twentieth foot backward.

Synonyms.

1840. *Lumbriconereis unicornis*, Grube. Actin. Echin. u. Würm., p. 80.
1843. „ *pectinifera*, De Quatrefages. Mag. de Zool., 2e sér., v, p. 6, pl. ii, f. 3—8.
1861. *Nematonereis unicornis*, Schmarda. Neue Wirb. Thiere, ii, p. 119, pl. xxxii, f. 254.

[1] Unfortunately the only example available for illustration was injured (Plate LXIII, fig. 5).

1864. *Lumbriconereis unicornis,* Claparède. Glanures Zoot., p. 112, pl. iv, f. 2.
1865. *Nematonereis pectinifera,* De Quatrefages. Hist. Nat. des Annel., p. 372.
,, ,, *Grubei,* idem. Ibid., p. 373.
,, ,, *contorta,* idem. Ibid., Explic. des Planches, p. 13, pl. viii, f. 24—27.
,, *Lumbriconereis unicornis,* idem. Ibid., ii, p. 652.
1868. ,, *oculata,* Ehlers. Borstenw., p. 374, Taf. xvi, f. 19—22.
,, *Nematonereis unicornis,* Claparède. Annél. Nap., p. 151.
1875. ,, ,, Marion and Bobretzky. Ann. Sc. nat., 6e sér., t. ii, p. 15.
1879. ,, ,, Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxiii, p. 295.
1885. ,, ,, Carus. Fauna Medit., p. 214.
1903. ,, ,, McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 560.
1904. ,, ,, Allen. Journ. M. B. A., n.s., vii, p. 225.
1905. ,, ,, Willey. Rep. Ceylon Pearl F., iv, p. 284.
,, ,, *oculata,* Graeffe. Arbeit. Zool. Stat. Triest, xv, p. 321.
1906. ,, ,, De St. Joseph. Ann. Sc. nat., 9e sér., t. iii, p. 213.

Habitat.—Amongst muddy sand in fissures of gneiss between tide-marks, St. Peter Port, Guernsey. Plymouth (Allen).

Ceylon (Willey). Off Pernambuco. Cape Verde Islands. Sea Point, Cape Town, probably. Canaries and Madeira (Langerhans).

Head evenly rounded in front, forming a short blunt cone. At its posterior border are two large black eyes, and between them a subulate median tentacle which is less than the antero-posterior diameter of the head.

Body five to six inches or more long, pale pinkish iridescent anteriorly with a red line from the dorsal vessel, and a central streak from the intestine, whilst this posteriorly is pale orange from its glands, the rest being pale cream-coloured. The annelid is nearly cylindrical from end to end.

Proboscis (Plate LXIII, fig. 5).—The maxillæ are short and strongly hooked anteriorly —like the upper half of the letter S. At the posterior end a dark brown band separates them from the posterior appendages which have an elongated conical outline. The anterior plates have a triangular brown patch in front. The great dental plates have a series of comparatively large teeth four or five in number. The mandibles (Plate LXIII, fig. 5 *a*) are hatchet-like, and the expanded anterior blade is marked by parallel lines.

The first two segments are devoid of feet, the anterior being somewhat broader than the posterior. The first foot is small and has a short, subulate, almost conical dorsal cirrus, and an ovate, massive ventral cirrus. The setigerous region is little developed, being less than the ventral cirrus, and has a single dark brown spine. The dorsal bristles have tapering winged tips. Below the spine is a group of jointed hooks, the distal process being winged and bifid at the tip—the whole differing little from the same structures in the tenth foot.

At the tenth foot (Plate LXXV, fig. 3) the dorsal cirrus has considerably elongated —forming a subulate organ. It is now separated by a considerable interval from the deep, truncated setigerous region, bearing dorsally a group of four winged bristles (Plate LXXXIV, fig. 1), which have the tips dilated above the shaft and then rather abruptly narrowed to finely tapered and long processes. The wings are minutely striated. Below there is a group of smaller winged bristles with finely attenuate tips. Appearances would seem to indicate that the setigerous lobe has a flap.

The foregoing are above the single strong brown spine. Below the spine are the jointed hooks which have the dilated end of the shaft minutely serrate (Plate LXXXIV, fig. 1 *b*). The ventral cirrus is now pear-shaped from the outward growth of a conical process. The vascularity of the foot is great.

At the twentieth foot (Plate LXXV, fig. 3 *a*) a single powerful brown spine supports the setigerous region, which has similar bristles and hooks. A single large hook crosses the spine obliquely from above and projects over the ventral cirrus. It has a broad wing at the tip, and the main fang is large (Plate LXXXIV, fig. 1*a*). In the foot, however, the secondary process above the main fang is not distinct. The dorsal cirrus is more slender.

At the fiftieth foot the dorsal cirrus is even more slender than in front, and has a distinct granular (glandular) enlargement at its ventral base. A single group of winged bristles emerges above the spine, their wings are narrower, curves less marked, and tips very attenuate. Below the spine the jointed bristles have increased in strength, the distal ends of the shafts are striated, and a few serrations occur on the edge of the wings guarding the terminal piece. The whole region is less and its outline more convex (less flattened). The powerful hook projects above the ventral cirrus—which extends beyond the massive glandular pad as a blunt cone. In this foot a brush-shaped bristle (or two) occurs amongst the dorsal bristles (Plate LXXXIV, fig. 1 *c*).

Proceeding backward the dorsal cirrus becomes less, but the glandular swelling remains at its ventral base. The setigerous region forms a broad cone with the tip of the powerful brown spine at the apex. Dorsally is a small group of the two kinds of winged bristles (larger uppermost, smaller below), and one or two brush-shaped. The jointed hooks project further outward (are longer). The great hook has increased in strength, and extends as far as the tip of the ventral cirrus, which is elongated and somewhat lanceolate, whilst the glandular swelling has moved inward and is less.

Reproduction.—Claparède, in his 'Glanures' (1864), observes that in the females ova were only developed behind the sixty-second segment. The young *Nematonereis* has four eyes, but two disappear, and Gravier thinks that the maxillary apparatus of this and *Lysidice* resemble each other. De St. Joseph found the minute young pelagic.

Habits.—It is fond of coiling itself in the vessel like a corkscrew, but this is probably connected with its surroundings.

This was one of the fruits of Prof. Ed. Grube's researches on the fauna of the Adriatic and Mediterranean, published in 1840.

Ehlers (1868) gives the species four eyes.

The *Nematonereis Schmardæ* of the 'Challenger,'[1] from the south of Pernambuco, is a closely allied form, but does not appear to be identical, and like the British form lives in mud (red). The same form would appear to range to St. Vincent, Cape Verde Islands, and to Cape Town, at both of which places fragments were obtained by the 'Challenger.' Schmarda found it in the Atlantic, and Willey in Ceylon.

It would seem that the three species mentioned by De Quatrefages (1865) may be varieties of the same form.

[1] 'Annelida,' p. 262, pl. xxxvii, figs. 6—8; pl. xviiiA, figs. 16—19.

Grube (1870), who examined the specimens in the Parisian Museum, showed that the *Blainvillea* of De Quatrefages was a *Nematonereis*.

Nematonereis sp. Plate LV, figs. 7 and 8—head and tail; Plate LVI, fig. 6—body.

A form sent by Dr. Allen from Plymouth differs considerably in outline from the foregoing, and is much less rigid, yet the general structure appears to agree. The loss of the example by the artist after delineation prevents a satisfactory decision. This form is considerably paler than that from the Channel Islands, has about seventy segments, and the tail (Plate LV, fig. 8) has two shorter and two longer cirri. The head (Plate LV, fig. 7) agrees with *N. unicornis*, and the dental armature is similar, but the feet are somewhat longer and more conspicuous and the spines are dark. The colour anteriorly varies from pinkish to pale green, then the intestine gives a brownish hue to the central region, whilst the posterior region is brownish-yellow.

Kinberg's[1] third family of the Eunicea is the Lysidicea, distinguished by seven maxillæ, part Ii edentate; three tentacles, neither antennæ nor palpi; buccal segment double. Of the genera—*Amphiro* and *Lysidice*—the former is distinguished by the presence of pectiniform branchiæ, whilst the latter has none.

Genus LXXIII.—Lysidice, *Savigny*, 1820.

Head free from the buccal segment, bearing three tentacles and two eyes; two large palpi.

Feet with cirri, bristles, and spines.

1. Lysidice punctata, *Risso*. Plate LV, fig. 3; Plate LXIII, figs. 6 and 6 *a*—teeth;[2] Plate LXXV, figs. 4–4 *b*—feet; Plate LXXXIV, figs. 2–2 *a'*, and 9—bristles.

Specific Characters.—Head broad and flattened, with a median notch anteriorly, while inferiorly are two thick prominent palpi. Median tentacle is short and somewhat fusiform, tapering distally, and situated rather in front of the lateral. Eyes two, black, of considerable size. Colour pale brownish, dappled with pale dots. Body 6—7 ins. long, tapering a little anteriorly, but more distinctly so posteriorly, where it terminates in four caudal processes. The first three segments are of a deeper brown hue and dappled with pale spots. First and second devoid of feet. The fourth segment is pale or whitish anteriorly, and in some the whole segment is white (Ehlers). The brownish colour with pale dots continues to the twentieth or twenty-fifth segment, and then fades into the paler brownish iridescence of the succeeding region. Segments in the middle and posterior part of the body boldly marked.

Proboscis has strong, curved maxillæ, with a shoulder posteriorly and long posterior appendages with a notch in the middle. Great dental plates have four prominent teeth on each side anteriorly—the antero-lateral plates. The mandibles are proportionally

[1] 'Öfvers. af K. Vet.-Akad. Förh.,' 1864, No. 10, p. 565.

[2] As *L. Ninetta*.

large and deeply concave from side to side, so that about half the length of the upper jaw-apparatus lies in the hollow curved anterior region. A longitudinal black bar on the upper surface. Foot with a dorsal cirrus slightly constricted at the base, and, in spirit, not extending beyond the tips of the bristles. Setigerous region a flattened cone with two strong yellowish spines (tenth foot). The dorsal bristles are curved at the end of the shaft, and the winged tip tapers to a fine point. Below the spines are jointed bristles, dilated at the end of the shaft and serrated on the convex edge. Terminal piece short, with a bifid hook and two wings. In the posterior feet a strong hook passes obliquely downward and pierces the skin below the compound bristles.

Synonyms.

1826. *Leodice punctata,* Risso. Hist. Nat. de l'Europe, t. iv, p. 421.
„ „ *triantennata,* idem. Ibid., p. 422.
1833. *Lysidice Ninetta,* Audouin and Edwards. Ann. Sc. nat., t. xxvii, pl. xii, f. 1—8; t. xxviii, p. 235.
1834. „ „ idem. Hist. Annél., p. 161, pl. iii B, f. 1—8.
1836–7. „ „ M. Edwards. Cuvier's Règne Anim. Illust., pl. xi, f. 1 and 1 *a*.
1844. „ *torquata,* De Quatrefages. Ann. Sc. nat., 3e sér., t. xiv, p. 361.
1851. „ *Ninetta,* Grube. Fam. Annel., pp. 45 and 124.
1853. „ *rufa,* Gosse. Ann. Nat. Hist., ser. 2, vol. xii, p. 385.
1855. „ *punctata,* Grube. Arch. f. Naturges., Jahr. 21, p. 95.
1863. „ *Ninetta,* Keferstein. Zeitschr. f. wiss. Zool., Bd. xii, p. 101, Taf. ix, f. 10—16.
1864. „ *punctata,* Grube. Insel Lussin, p. 79.
„ „ *Mahagoni,* Claparède. Glanures Zoot., p. 116, pl. ii, f. 4.
1865. „ *Ninetta,* De Quatrefages. Annel., i, p. 375.
„ „ „ Johnston. Cat. Worms Brit. Mus., pp. 140 and 341.
„ „ *rufa,* idem. Ibid., pp. 141 and 341.
„ „ *torquata,* De Quatrefages. Annel., i, p. 376, pl. ix, f. 19, 20.
„ *Leodice triantennata,* idem. Ibid., p. 354.
1867. *Lysidice Ninetta* and *rufa,* Parfitt. Trans. Devon. Assoc., ii, p. 20 (sep. copy).
1868. „ „ Ehlers. Borstenw., ii, p. 366, Taf. xvi, f. 12—18.
„ „ *punctata,* Grube. Mitth. St. Vaast-la-Hougue, etc., p. 36 (126).
1870. „ *torquata,* idem. Arch. f. Naturges., Bd. xxxvi, p. 301.
1875. „ *Ninetta,* Marion and Bobretzky. Ann. Sc. nat., 6e sér., t. ii, p. 15.
1878. „ „ Grube. Schies. Gesellsch., 20th June, 1877, p. 25 (sep. abdr.).
1879. „ „ Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxiii, p. 295.
1881. „ „ idem. Canar. Annel. in Nova Acta Leop.-Car., xlii, p. 112.
1885. „ „ Carus. Fauna Medit., p. 213.
1903. „ „ McIntosh. Ann. Nat. Hist., ser. 7, vol. xi, p. 560.
1904. „ „ Allen. Journ. M. B. A., n.s., vii, p. 225.
1905. „ „ Graeffe. Arbeit. Zool. Stat. Triest, xv, p. 321.
1906. „ „ Bohn. Ann. Sc. nat., 9e sér., t. iii, p. 101.

Habitat.—Abundant in fissures of gneiss in Guernsey in muddy sand. If the rock is easily split, from the presence of an old crack, the greater is the probability of obtaining large specimens. A fragment also occurred in the Gouliot Caves, Sark. At Herm small specimens are frequently obtained along with *Polydora*, *Dodecaceria*, and other Annelids, by breaking off the coating of *Lithothamnion* on stones between tide-marks. Whether it merely occupies the holes made by other forms or whether it enlarges these is an open

question. It also occurs under the large coarse Ascidians, the test of which forms the arch of the tunnel, the stone forming the base. It probably enlarges its tunnels. It also was found in *Cellepora* dredged off St. Peter Port, and amongst the roots of *Antennularia* and sponges (Col. Fraser and Capt. Powell) off the south coast of Sark. Isle of Wight, Luccomb Chine (W. C. M.). Weymouth (P. H. Gosse). Plymouth (Baird and Allen). It extends to Ireland, where it has been procured at Connemara (A. G. Moore) and Galway (Prof. E. P. Wright).

Shores of France. Keferstein found them in tubes of mucus and mud near low water-mark at St. Vaast; Mediterranean; Canaries (Langerhans).

Head broad and flattened, with a median notch anteriorly, while inferiorly are two thick prominent lobes (palpi). Eyes two, black, of considerable size. The median tentacle is a short, somewhat fusiform process, constricted at the base and again diminished toward the tip. It is placed somewhat in front of the two lateral tentacles, which have a similar shape. The colour of the head is pale brownish dappled with pale dots, the nuchal border being rather darker.

Body elongated, reaching 6—7 ins., slightly tapering anteriorly and more decidedly so posteriorly, where it terminates in four caudal processes—two longer dorsal and two shorter ventral cirri, the former being also wider at the tips. The dorsal arch is rounded, the ventral surface flattened, with a median groove, and uniformly tinted.

The first three segments are tinted of a deeper brown hue than the rest of the body and dappled with pale spots. The first is broader than the two succeeding. The first and second are devoid of feet, as in *Notocirrus*. The fourth segment is pale anteriorly, and thus makes a contrast with the preceding. In some the posterior border of this segment is brownish, speckled with pale dots. In others the fourth segment is white, as also is the half of the succeeding (Ehlers). The coloration indicated (brownish with pale dots) stretches to the twentieth or twenty-fifth segment, and fades into the general brownish iridescence of the body, with a slight shade of purple. A specimen trawled off the south coast of Sark by Col. Fraser and Capt. Powell had only a white patch between the eyes, instead of the usual white belt on the fifth segment.

The segments in the middle and posterior part of the body are boldly outlined, while the feet are less differentiated, the bristles being borne on the prominent edge of the segment, which is also marked by a transverse median ridge. Posteriorly the body terminates in four cirri, which spring from below the vent, the upper being longer than the inferior pair and their bases wider apart.

The proboscis (Plate LXIII, fig. 6) has a pair of strongly curved maxillæ with a shoulder posteriorly, and long, slightly tapered posterior appendages, which have a shallow notch in the middle. The great maxillary plates have four prominent teeth on each side anteriorly; the curved anterior plate on the left has four rather blunt and rounded teeth, that on the right about six, each has a blunt conical nodule in front, and there are horny bars laterally. The mandibles (Plate LXIII, fig. 6 *a*) are proportionally large and deeply curved from side to side, so that in many preparations the upper jaw apparatus lies in the cavity thus formed. This curved anterior region is large, occupying about half the total length of the teeth. It has on its upper surface a longitudinal black bar. The dental limbs posteriorly terminate in two blunt processes.

The first foot has a short dorsal cirrus somewhat tapered distally, a slight setigerous lobe bearing both simple and compound bristles, and a short ovate ventral cirrus. In the upper tuft of simple bristles are a few brush-shaped forms. The foot has a single spine.

At the tenth foot (Plate LXXV, fig. 4) the dorsal cirrus is longer, forming a tapering process slightly constricted at the base. It does not extend in spirit beyond the tips of the bristles. The setigerous process has greatly increased in size, forming a broad (or deep) flattened cone with two strong yellowish spines. The simple winged dorsal bristles (Plate LXXXIV, fig. 2) are curved at the commencement of the tip, which is somewhat dilated, and then tapers rather quickly to a fine point. The edges of the wings are finely serrate. These bristles issue above the spines.

Beneath the spines is a dense group of the jointed bristles (Plate LXXXIV, fig. 2 *a*), the shafts being enlarged and curved toward the end, and serrated along the convex edge. When the bristle is seen from the front only one of the convex edges is distinctly spinous, the other being faintly so, but this may be due to position. The terminal piece is comparatively short, has spinous wings, a double tip from a lateral hook, and a terminal spur.

At the thirtieth foot (Plate LXXXIV, fig. 4 *a*) a single spine supports the setigerous region, its point projecting beyond the edge. A strong hook, however, passes obliquely downward and pierces the skin below the compound bristles, which are somewhat larger than in the tenth foot. The hook (Plate LXXXIV, fig. 2 *a*) has a double wing at the tip, which is bifid.

The structure of the simple and especially the compound bristles is more satisfactorily made out in the fiftieth foot (Plate LXXV, fig. 4), the latter kind being considerably larger than in the tenth foot. A single strong spine is present, and the powerful hook (Plate LXXXIV, fig. 9) occupies the position indicated in the thirtieth foot.

In the posterior feet, viz., those in front of the tail, the dorsal cirrus becomes shorter, projecting outward little beyond the tip of the setigerous region, which forms a broad short cone, with the spine piercing the apex. The dorsal bristles are fewer and shorter, but their serrations are very distinct. The compound bristles are also shorter and fewer, and the serrations on the enlarged ends of the shafts are somewhat indistinct. The ventral hook has the same oblique position, its brownish shaft crossing that of the spine. The ventral cirrus is very short, bluntly conical, and does not reach a vertical line from the apex of the setigerous region.

In some the spine towards the tip of the tail is dark brown. Occasionally two occur, similarly coloured. A developing hook, again, is pale.

Reproduction.—In the beginning of April the females from Jersey carried ova—far advanced. Lo Bianco[1] gives November as the month in which he found this species ripe at Naples.

The young form has two pairs of eyes but only a median tentacle. By-and-by the paired tentacles develop and the two anterior eyes disappear.[2]

The *Nereis cristatella* of Montagu (MS. drawings, Linn. Soc., Plate XXXVI, fig. 3, 1808) appears to be this species.

[1] 'Mitth. Zool. Stat. Neap.,' xiii, p. 487.

[2] Gravier, 1900.

The *Lysidice Mahagoni* of Claparède (1864) may be included in this species, for the only distinction is the absence of the slight median notch in the anterior border of the snout.

De Quatrefages (1865) placed this form amongst his Lumbriconereids.

Ehlers (1868) rightly made considerable reformation in the synonymy of this abundant southern form. Apparently a considerable change is also necessary in the synonymy of foreign species.

The *Lysidice margaritacea* of Claparède [1] from the Mediterranean seems to be closely allied, though the spines are black.

The *Lysidice collaris* of Grube [2] from the Red Sea does not appear to differ essentially from *L. punctata*. The comparatively slight differences existing in the teeth of such species as this, and the close approach in the structure of the bristles and other features, is suggestive.[3] This author [4] considered Risso's *L. punctata* as identical with *L. Ninetta*, Aud. and Edw.

The occurrence of a *Marphysa* at Marseilles, viz., *M. fallax*, Marion and Bobretzky,[5] mimicking this species so closely that they are readily confounded, is interesting, whether the form is other than the young of the common *Marphysa* or not.

Family XII.—Goniadidæ, *Malmgren*, 1865 (=Goniadea, *Kinberg*, 1865).

Cephalic lobe elongate, tapering, with four equal terminal processes. Horny teeth in two to five rows, terminal lateral, dorsal transverse, ventral transverse and radiate. Feet biramous in the middle and posterior part of the body.

Grube's[6] seventh family, Glycerea, included both *Glycera*, Sav., and *Goniada*, Aud. and Edw.

Kinberg (1865) made a somewhat minute subdivision of the groups of teeth, which he termed maxillæ, ranging them into angular, terminal, lateral, transverse, transverse dorsal, and transverse ventral maxillæ. He describes the "branchiæ" as terminal, probably referring to the tips of the processes of the feet. He divides the genera according to the presence or absence of the angular teeth into two divisions, and subdivides by the number of the transverse maxillæ and terminal maxillæ.

The view of Ehlers (1868) that *Goniada* and *Glycinde* should form one genus has certain recommendations, but it should be remembered that the structure of the dorsal division of the foot, both in soft parts and in bristles, shows a decided divergence, and the same may be said of the teeth.[7] Moreover, Ehlers does not mention that between the body-wall of each of the common forms (*Goniada maculata* and *Glycinde*

[1] 'Annel. Chét. Nap.,' p. 143, pl. viii, fig. 3, 1868.
[2] 'Monatsb. Kgl. Akad. Wiss. Berlin,' June, 1869, p. 15 (sep. copy).
[3] Vide, for instance, Marenzeller, 'Sudjap. Annel.,' p. 136, Taf. v, fig. 2, 1879.
[4] 'Mitth. St. Vaast-la-Hougue,' p. 108.
[5] 'Ann. Sc. nat.,' 6e sér., t. ii, p. 13, 1875.
[6] 'Fam. der Annel.,' p. 59, 1851.
[7] '"Challenger" Annel.,' p. 342.

Nordmanni) there is this difference, viz., that in the latter the dorsal longitudinal muscles have a well-marked fold inferiorly, whilst in the former such is not present.

The Goniadidæ formed the first family of the Euniciformia Glycerina of Levinsen (1883), and fall under Benham's Glyceridæ, the tenth family of the Nereidiformia. In the former classification there is no doubtful association, whereas in the latter the Sphærodoridæ follow, and then the Ariciidæ.

Goodrich observes that, as in *Nephthys* and *Glycera*, the segmental organ in *Goniada* (Fig. 86) has no opening into the cœlom, whilst a ciliated canal leads to the exterior—through the septum, where it enlarges to form a lobed terminal organ—intermediate between *Nephthys* and *Glycera*. The ciliated organ acts as a genital duct in *Goniada maculata*. Fage,[1] again, sees in the closed nephridium, with its four rows of solenocytes, and in the sudden development of the genital funnel at the moment of reproduction for

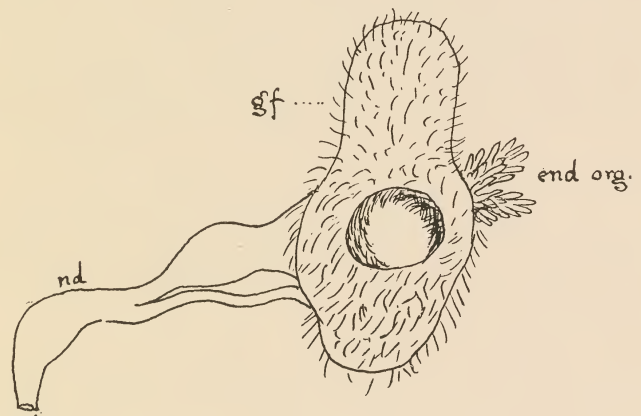


Fig. 86.—Diagrammatic reconstruction of the nephridium and genital funnel of a ripe *Goniada maculata* (Goodrich).
end org. End organ. *gf.* Genital funnel. *nd.* Nephridial duct. *np.* Nephridispore. (Goodrich.)

the transmission of the sexual elements, a parallelism rather with the Phyllodocidæ than the Glyceridæ.

Ehlers (1868) groups his *Glycerea polygnatha* (Goniada) as follows :—

A. The terminal region of the proboscis without jaw-plates.

Two jaws with hooks and twenty paragnathi.

Ex. *Eone Nordmanni*, Malmgren.

B. The distal region of the proboscis with two rows of horny points (paragnathi).

1. Two chief jaws, several V-shaped jaws.

Ex. *Goniada maculata*, Œrst.

2. Two chief jaws and a ring of spiked horny points.

C. Surface of the proboscis with two longitudinal rows of horny points, with smaller points on the ventral surface and angular plates on the side.

Ex. *Glycinde multidens*, F. Müller.

It is probable that the British forms range to America, and that, perhaps, the synonymy of the species requires readjustment.

[1] 'Ann. Sc. nat.,' 9e sér., t. iii, p. 311.

Genus LXXIV.—Goniada, *Audouin and M. Edwards.*

Head slender, elongated and conical, with four terminal tentacles. Body rounded anteriorly, flattened posteriorly; segments with two rings. Proboscis minutely papillose, with a row of V-shaped denticles on each side toward its base, and at its end two larger pectinate jaws and an adjacent series of smaller denticles. Feet single in front, double behind, the former having compound bristles, the latter both simple (dorsal) and compound. The nerve-cords (Fig. 87) lie below the insertion of the oblique muscles, which pass from below the bristle-bundles on each side with a slight inclination downward and inward, and meet for insertion on each side of the hypodermic wedge above the nerves, which lie in a somewhat triangular or pyriform area of the hypoderm, and each has a small neural canal toward the upper and narrow part in section. Segmental organs open ventrally, whilst internally they end in a tuft of short blind branches provided with solenocytes. Genital funnel is trumpet-like and ciliated, fuses with and then opens at maturity into segmental canal, and thus conveys genital products to the exterior (Goodrich).

1. Goniada maculata, *Œrsted*, 1843. Plate LVI, figs. 2 and 3; Plate LXIV, figs. 6–6 *d* —head, teeth; Plate LXXV, figs. 12–12 *a*—feet; Plate LXXXV, figs. 1–1 *a'*—bristles.

Specific Characters.—Head an elongated tapering conical process, with four short tentacles at the tip, and consisting of eight segments. Body 4—6 ins. in length, tapered anteriorly and posteriorly, rounded in front, flattened posteriorly, and terminating in two

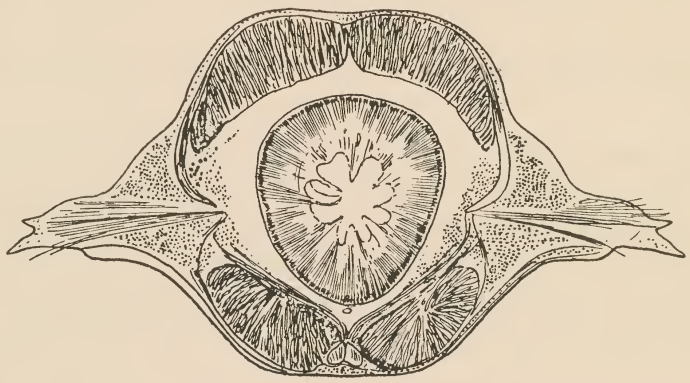


Fig. 87.—Transverse section of the anterior third of *Goniada maculata*. Enlarged.

slender cirri. Proboscis has towards the base a row of about ten dark brown V-shaped denticles on each side. They diminish in size distally, and also to some extent proximally, in extrusion. Distally the organ has a circle of about twenty bluntly conical papillæ, and within this are two lateral denticles with a rounded base and a toothed distal region. A series of *x*-shaped intermediate small denticles, varying in size, forms a belt between the larger pair. Feet simple in front, with three long papillæ or lobes, but with two divisions at the twentieth foot, the dorsal having a spine, a lanceolate lobe with a process at the base

dorsally, and a group of simple bristles. The ventral division has an upper, a middle, and a ventral lobe, a strong spine, and two groups of compound bristles. The feet increase in length posteriorly, especially the tips of the processes of the ventral division.

Arwidsson[1] found a reduced blood-system in *Goniada maculata* as well as in *Glycera*, and the perivisceral corpuscles are similar in both, especially those containing hæmoglobin.

Synonyms.

1843. *Goniada maculata*, Œrsted. Annul. Danic. Consp., p. 33, f. 16, 23, 91, 95, 97, 98.
„ „ „ idem. Regionis Marinis, p. 78.
1844. (?) „ *minuscula*, De Quatrefages. Ann. Sc. nat., 3e sér. 14, p. 359.
1844—5. *Glycera viridescens*, Sars. Nyt Mag. f. Naturvid., vi, p. 381.
1851. *Goniada maculata*, Grube. Fam. Annel., pp. 60 and 131.
1853. *Glycera viridescens*, Stimpson. Mar. Invert. Grand Manan, p. 33.
1865. *Goniada maculata*, Johnston. Cat. Worms Brit. Mus., p. 189.
„ „ „ Carrington. Annel. Southport, pp. 6 and 7.
„ „ „ De Quatrefages. Annel., ii, p. 193.
1867. „ „ Malmgren. Annul. Polych., p. 182.
1868. „ „ Ehlers. Borstenw., ii, p. 704, Taf. xxiv, f. 36—48.
1873. „ „ Kupffer. Jahresb. Comm. deutsch. Meere ('Pommerania'), p. 150.
„ „ „ Verrill. Americ. Journ. Sc. and Arts, vol. v, p. 103.
„ „ „ Sars. Bidrag Christ. Fauna, iii, p. 30.
1874. „ „ Smith and Harger. Trans. Conn. Acad., iii, pp. 13—16.
„ „ „ Malm. Göteb. vet. o. vitt. Handl., xiv, p. 86.
„ „ „ McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 200.
1875. „ „ Möbius. Jahresb. Comm. deutsch. Meere ('Pommerania'), p. 169.
„ „ „ McIntosh. Invert. and Fishes St. Andrews, p. 123.
1879. „ „ Tauber. Annul. Danic., p. 103.
„ „ „ Hansen. Nyt Mag. f. Naturvid., xxiv, p. 268.
„ „ „ Langerhans. Zeitschr. f. wiss. Zool., xxxiii, p. 302, Taf. xvi, f. 37.
1886. „ „ Harvey Gibson. Proc. Lit. Phil. Soc. Liverp., vol. xi, p. 155.
1893. „ „ Levinsen. Vidensk. Ud. "Hauchs," p. 332.
1897. „ „ Arwidsson. Bid. t. k. Svensk. Vet.-Akad. Handl., Bd. xxiii, aft. iv, No. 6, p. 8, Taf. i, f. 3—10.
1898. „ „ idem. Bergens Mus. Aarb., No. xi, p. 36, pl. ii, f. 25—28, and pl. iv, f. 60 and 61.
1901. „ „ Whiteaves. Geol. Surv. Canada, No. 722, p. 79.
1905. „ „ McIntosh. Ann. Nat. Hist., ser. 7, vol. xv, pp. 37 and 51.

Habitat.—The frequency with which this species was encountered in the stomachs of the cod and haddock at St. Andrews by my mother was remarkable. It also frequents the sand near low water-mark at St. Andrews, especially near the entrance to the harbour at the East Sands. Dredged in muddy sand twenty-five miles west of Valentia (J. G. Jeffreys). S.W. Ireland, log 55, 1886; Bantry Bay, thirty-five fathoms, 1866, R.I.A. Valentia Harbour (J. G. Jeffreys). S.W. Ireland, 110 fathoms off the Blasquet (J. G. J.). In the Minch (off Hebrides) (J. G. J.), July, 1866. Seventy fathoms, Outer Haaf,

[1] 'Bih. k. Vet.-Akad. Handl.,' Bd. xxiii, p. 8, Taf. 1, figs. 3—10.

Skerries, 1868 (J. G. J.). St. Magnus Bay, Shetland, eighty to one hundred fathoms (J. G. J.). Dingle Bay, Ireland, thirty to forty fathoms, stones and sand, 'Porcupine,' 1869.

Examples of the second type come from the Minch, off Bergen, Norway (A. M. Norman). Denmark, Sweden, and Finmark. 'Porcupine,' 1870, at Station XVII A, in 795 fathoms, and in Bono Bay in twenty-five fathoms, and Station XXIX, 227 fathoms; bottom temperature, 53° F. North Sea (Ehlers). Madeira, where it is smaller than in the North Sea (Langerhans). North America. Canada (Dr. Whiteaves).

Head (Plate LXIV, figs. 6 and 6 *a*) forming a tapered or elongated conical process, with four short cirri anteriorly, and consisting of eight segments.

Body about 4—6 ins. long and of 194 segments (Ehlers), tapered at each end, but much more distinctly so anteriorly, rounded in front, and becoming more flattened towards the middle and posteriorly, and terminating in the vent, below which are two cirri of moderate length. Female of a pinkish colour in front as far as the change in the feet, then dusky brown, with a tinge of olive throughout the rest of its extent, the dorsum being mottled with brown marked by pale lines and separated at each segment-

Fig. 88.—Teeth of *Goniada maculata*, from a Canadian example. Enlarged.

junction. Just in front of each junction a transverse line cuts off a narrow segment of the brown pigment. The ventral surface is pale pink in front, greenish throughout the rest of its extent from the large ova. These were extruded from the broken posterior end of the animal, and had a very transparent capsule, with pale greenish yolk. The eggs are comparatively large, though perhaps not quite ripe, and measure about ·0105 mm. No eyes. Six V-shaped denticles on one side and six or seven on the other in this example.

Another example, also a female (16th June, 1904), was of a fine scarlet colour, paler towards the snout—which was pale at the tip and pinkish behind, and dull yellowish towards the tail. The red colour seemed to be generally diffused dorsally and ventrally over those parts having it, and was bright at the bases of the feet, which showed some pale patches, giving them a mottled aspect. Anteriorly the iridescent dorsum was divided into a median and two lateral areas, the latter striated by longitudinal creases in the segments, but at the change of segments this ceased, the dorsum then showing a similar disposition to that in the foregoing female, though the pigment was red, the narrow bar in front of the segment-junction being distinct. This remarkable coloration does not appear to be due to the perivisceral fluid, which was pale, but to pigment in muscles and other parts, as further examination proved, for this was likewise loaded with pale greenish ova with large nuclei. The muscles of the proboscis and other parts appeared to be reddish.

The tail is dull greenish on the dorsum and on the feet, and terminates in a moderately tapered region ending in the vent, below which are two cirri of average length—also dull greenish.

The proboscis (Plate LXIV, fig. 6 *a*) is elongated and cylindrical, the first or basal region (in extrusion) being minutely and densely papillose. The papillæ become fewer in the distal region, and disappear before reaching the ring of large papillæ at the tip. When firmly contracted the proboscis is closely striated. The basal region is armed by a row of dark-brown V-shaped denticles on each side (Plate LXIV, figs. 6 *a* and 6 *b*), about ten in number in well-developed examples. They diminish in size distally (in extrusion), and also are somewhat less at the proximal end. Slight variation occurs in these teeth. Thus Norwegian examples show the V-shaped teeth with longer limbs and more acute apices, and they are also more closely arranged, though not more numerous. In some British specimens a smaller number may exist on one side, and the last may be irregularly formed or in two pieces. At the end of this region of the organ is a circle of twenty papillæ, of a bluntly conical form, and just within them two lateral denticles (Fig. 89) and a few smaller intermediate ones. The larger denticles have a rounded or globular end, connected by a neck with the somewhat palmate distal region which has two large curved teeth (Plate LXIII, fig. 6 *d*), the distal fang of great proportional size, the next smaller, and the succeeding teeth gradually diminishing, the whole number being from six to eight, the British examples presenting a much less globular basal end than that shown by Ehlers.[1] The general outline in Norwegian examples agrees, though the number of processes or teeth may vary. The intermediate small denticles (Plate LXIV, figs. 6 *c* and 6 *c'*) vary in aspect according to the position, as a rule having a basal end with two flattened lobes or plates, a body terminated by two diverging main fangs, and a smaller lateral fang on each side; but when viewed from the inner surface of the gullet four projecting spikes meet the eye. Three of these occur in a row between the two larger teeth, and on the opposite wall of the organ a pair of small V-shaped denticles are found, and often another near each great denticle. The retractor of the proboscis is very long. The buccal (peristomial) segment is about three times the antero-posterior diameter of the preceding, and increases considerably in transverse diameter. The next segment bears the first foot, which has two somewhat elongated lower lobes with bristles between and above, and superiorly a flattened process continuous with the upper border of the former, and representing the superior lobe or lamella.

At the tenth foot (Plate LXXV, fig. 12) a single median spine occurs in the conical setigerous region, with a tuft of bristles superiorly and inferiorly, a long median papilla, and a dorsal and a ventral elongated lamella (cirrus) tapered at the tip. The dorsal has a flattened and slightly enlarged tip, a condition due to constriction or sinuosity of the margin. The foot is thus characteristically trifid.

At the twentieth foot the three lobes and the bristles have a similar arrangement, and so at the thirtieth foot, which, however, is somewhat larger. Between this and the subsequent region a change in the complexity of the foot occurs, often about the forty-first or forty-second.

[1] Op. cit., pl. xxiv, fig. 43.

At the fiftieth foot (Plate LXXV, fig. 12 *a*) is a rather elongated slightly tapered dorsal lobe, which appears to be homologous with a cirrus. Then the dorsal bristles with their supporting spine occur above the large lanceolate lamella beneath. Inferiorly is the rounded setigerous process of the region with its spine, and two groups of bristles, whilst two long conical papillæ project distally. At the ventral edge is a conical cirrus, which does not project so far as the former.

The foot remains of similar structure till near the tip of the tail, the lobes somewhat increasing in length, as also do the bristles. The bristles of the ventral lobe considerably exceed the others, their very long terminal pieces projecting far outward. In the caudal region the lower division shows superiorly three lobes, an upper and under and a smaller median, with the ventral inferiorly.

The structure of the feet just detailed is observed in examples from the Outer Haaf, Skerries, Shetland, from St. Andrews, Norway, and Canada. It is therefore the least complex, both anteriorly and posteriorly. A tendency to the enlargement of the lobe beneath the dorsal cirrus exists in females with large ova from Canada. Considerable variety in regard to the length and breadth of the various lobes of the foot is observed.

The other type is that represented by examples from Cape Finisterre and Cape Sagres, in which the anterior feet have five processes, viz., a dorsal and a ventral cirrus, the former being near the base of the foot, a long and large posterior lobe, and two smaller anterior. The dorsal lobe is long and narrow, and has a slight constriction at its base. In this type the posterior feet have broadly lanceolate dorsal lamellæ and three long digit-like papillæ inferiorly—above the elongate ventral cirrus, as exemplified in the following species.

The dorsal bristles (Plate LXXXV, fig. 1) are translucent, with straight shafts, the tip having a slight bend and dilatation, then being finely tapered distally. The ventral bristles (Plate LXXXV, figs. 1 *a* and 1 *a'*) have long shafts, slightly curved toward the end. From the articulation the long, slender terminal piece tapers to a fine point. The tips of the posterior bristles, especially the central series in the fan, attain a much greater length.

Reproduction.—Some of those procured off the S.W. of Ireland had large ova in July.

Ehlers (1868) characterizes the proboscis as having small cordate papillæ, with a row of seven to nine arrow-shaped jaw-plates on each side, and with twenty terminal papillæ, two- to eight-toothed chief jaws, three ventral points, and four double points (paragnathi).

The *Goniada Alcockiana* of Dr. Carrington[1] appears to be a variety of this species, though, at first sight, the shape of the body leans to *Glycinde*.

2. Goniada eremita, *Audouin and M. Edwards*, 1834.

Specific Characters.—Head like that of *G. maculata*, with four short tentacles at the tip, and consisting of seven rings. Body elongated, four to seven inches in length and of 300 segments, rounded dorsally and slightly flattened ventrally, where a median groove

[1] 'Annel. of Southport,' 1865, p. 6.

runs from end to end, and with the feet deeply cut. The first sixty-six feet are uniramous three-lobed, with a lanceolate or sausage-like dorsal and a lanceolate ventral cirrus. The feet behind have two divisions, the upper with a leaf-like dorsal cirrus, a lanceolate lobe, and simple bristles; the inferior division boldly trifid, with a lanceolate ventral cirrus and compound bristles. Proboscis armed distally in extrusion with two large black teeth, each with a flattened base, a short curved and blunt process, and three curved teeth, whilst a belt of numerous spiked and complex denticles (somewhat *x*-shaped) occurs between them. Feet proportionally longer than in *G. maculata*, and from about the tenth have five processes, viz., a dorsal cirrus, a three-lobed spinigerous region, and a ventral cirrus. A change occurs at the sixty-ninth foot, the seventieth being biramous.

Synonyms.

1834. *Goniada eremita*, Audouin and Edwards. Annél., p. 247, pl. 7A, f. 1—4.
1865. „ „ De Quatrefages. Annel., ii, p. 191.
1868. „ „ Ehlers. Borstenw., ii, p. 704, Taf. xxiv, f. 49—51.
1875. „ „ Marion and Bobretzky. Ann. Sc. nat., 6e sér., t. ii, p. 17.

Habitat.—Specimens dredged in the 'Porcupine' Expedition of 1870 in eighty-one fathoms off Cape Finisterre, and in forty-five fathoms (eight miles N.W.) off Cape Sagres.

The *head* appears to be somewhat less attenuate than in the common form, but this may have been partly due to the complete extrusion of the proboscis.

Body somewhat larger and longer than in *Goniada maculata*, of a firmer consistence, more rounded dorsally, and grooved ventrally. First two segments without feet, the first the broader. Proboscis (Fig. 88) with fifteen to eighteen V-shaped teeth on each side. Rounded keel of the great fang less, and the adjoining flattened plate proportionally longer; terminal fang more massive, and the smaller teeth behind it fewer in number. The row of spiked *x*-shaped denticles is at least four times as numerous as in *G. maculata*. Anteriorly the feet are proportionally longer than in *G. maculata*, and about the tenth (Plate LXXXVII, fig. 20) have four lobes or papillæ, viz., a large lanceolate dorsal lobe (cirrus), which arises on the dorsal edge, nearer the base than the other processes, and has a constricted base; a larger and longer digit-like posterior lobe; and two slightly shorter anterior lobes which occur at the spinigerous region, whilst below is the long lanceolate ventral lobe or cirrus. Only compound bristles are present. This therefore differs from the condition described in *Goniada maculata*. At the thirteenth foot the dorsal cirrus is a long sausage-shaped structure with a constricted base, and it has now receded toward the body.

A considerable increase in length of the foot and its processes takes place at the twentieth foot, the dorsal cirrus arising near the base, its tip reaching outward dorsally to the middle of the foot. The long, pointed posterior lamella is prominent, and of the two smaller anterior processes the inferior is the less, the lanceolate ventral lobe or cirrus extending beyond the rest. At the thirty-first foot a single spine and only compound bristles are found, as in front, and so at the fiftieth foot. Immediately behind the fiftieth, however, a change occurs, two processes appearing instead of the single cirrus dorsally. In the example this took place at the fifty-third foot, a lamella being suddenly developed

beneath and external to the cirrus. At the seventieth foot the dorsal cirrus is now double (Plate LXXV, fig. 12 *b*), a long spathulate lobe inferiorly and a lanceolate lobe superiorly. A dorsal spine is also present, but there are no dorsal bristles.

In the posterior feet the vertical diameter has considerably increased, and the dorsal and ventral divisions are widely separated. The upper dorsal lobe is ovate and pointed at the tip, the lower is somewhat lanceolate (Plate LXXV, fig. 12 *c*). The dorsal bristles are simple and rather short, with a tapering tip slightly curved. A strong spine emerges at the border of the lower lobe. The inferior division is the longer, has a setigerous process with a strong spine, and a broad fan of compound bristles, the tips of which make a gradational series, the longer tips being median, the shorter superior and inferior. It has terminally a longer upper papilla or lobe (digit-like), and a pair of shorter lobes inferiorly. The region is completed by the flattened, conical ventral cirrus, the tip of which reaches the bases of terminal papillæ above it.

Fig. 89.—Lateral tooth of *Goniada eremita*, Aud. and Edw. Enlarged.

In their original description of this species from the Mediterranean, Audouin and Edwards (1834) overlooked the toothed jaws and the denticles toward the tip of the extruded proboscis, though they represented both in an allied species from New Holland. The characters of the anterior as contrasted with the posterior feet also escaped them.

De Quatrefages (1865) also omitted to notice the distal armature of the proboscis in extrusion. He, however, observed the distinctions between the anterior and the posterior feet, though he overlooked the dorsal bristles, which probably had been removed.

A careful account of this form was given by Ehlers (1868). In his examples the change in the dorsal division occurred at the sixty-third foot, somewhat more posterior than in the present form. The tail has two slender cirri. He describes the great length of the proboscis with its sixteen terminal papillæ, its pair of three-toothed jaws, and the band of smaller denticles, but his figure of the latter represents them as too minute.

Genus LXXV.—Glycinde, *Fritz Müller.*

Head acutely conical, generally of ten segments, the terminal having four small tentacles, whilst at the base dorsally are two small eyes. Body elongated, of two divisions, the anterior region more smoothly rounded and having simple feet, the posterior with two widely separate divisions of the foot, and stout dorsal bristles with a hooked tip and a long tapering wing. Proboscis has a row of papillæ slightly longer than in *Goniada*, and behind these two larger denticles with four to five hook-like teeth, and a series of smaller denticles, twenty-two to twenty-four in number, with several teeth (usually four). The anterior feet are trifid, and the lobes long and pointed. Bristles arranged in a fan and all compound, the longest tips occurring in the middle, and they are serrated. The posterior feet have diminished upper lobes and stout bristles with slightly mucronate tips and a tapering distal wing, a much enlarged lamella in front of the inferior setigerous lobe, and a diminished ventral lobe (cirrus).

1. Glycinde Nordmanni, *Malmgren*, 1866. Plate LXIV, figs. 7–7 *b*—body, tail, teeth; Plate LXXV, figs. 13–13 *d*—feet; Plate LXXXV, figs. 2–2 *b*—bristles.

Specific Characters.—Head of ten segments; two small eyes at the base dorsally. Body resembling that of *Goniada*, feet commencing as simple and short, then bifid and trifid organs as they increase in length, provided with short compound bristles. At the tenth foot three long lanceolate lobes, a single spine, and a fan-like arrangement of compound bristles in two groups. Before the fiftieth foot is reached the organ is bifid, with two spines, and a prominent double lobe in each division, the upper and lower representing the cirri. A change in the length of the foot occurs at the sixty-fifth foot. The lanceolate lamella of the ventral lobe greatly increases in size posteriorly (*e.g.*, one hundredth foot), and the mucronate bristles project from the dorsal division.

Synonyms.

1865. *Eone Nordmanni,* Malmgren. Nord. Hafs-Annul., p. 409.
1867. „ „ idem. Annul. Polych., p. 69, Tab. xi, f. 64.
1868. *Goniada* „ Ehlers. Borstenw., ii, p. 703.
1869. „ „ McIntosh. Rep. Brit. Assoc. (1868), p. 337.
1874. „ „ Malm. Göteb. vet. o. vitt. Handl., xiv, p. 86.
1875. „ „ Ehlers. Zeitschr. f. wiss. Zool., Bd. xxv, p. 56.
1879. „ „ Tauber. Annul. Danic., p. 104.
1883. „ „ Wirén. Chæt. 'Vega' Exped., p. 403.
„ „ „ Levinsen. Vidensk. Meddel. Foren. Kjöbenh., p. 221.
„ *Eone* „ idem. Ibid., p. 221.
1893. (?) „ „ idem. Vidensk. Ud. "Hauchs," p. 332, Tab. i, f. 1—6.
1898. *Glycinde Nordmanni,* Arwidsson. Bergens Mus. Aarb., No. xi, p. 50, pl. iii, f. 45—47; pl. iv, f. 64 and 65.
1905. „ „ McIntosh. Ann. Nat. Hist., ser. 7, vol. xv, p. 38.

Habitat.—In the stomach of the cod and flounder, St. Andrews Bay (E. M.). Not uncommon in St. Magnus Bay, Shetland, where it was first dredged by Dr. Gwyn Jeffreys

in eighty-five to one hundred fathoms in 1867. He also procured it off North Unst in ninety to ninety-five fathoms, and off Balta in fifty fathoms. In Bressay Sound it occurs in eighteen fathoms. In the 'Porcupine' Expedition of 1869 it was met with in Dingle Bay, Ireland, in thirty to forty fathoms, and at Station XXXVI in 725 fathoms in mud and sand. In the Expedition of 1870 it was dredged in 257 fathoms in the Atlantic on a bottom of sand and at a temperature of 49·7°. In 110 fathoms off the Blasquet (J. G. Jeffreys). Bay of Galway (E. P. Wright).

Siberian Coast (Wirén). Foreign forms like that of the 'Challenger' appear to come from comparatively shallow water.

Head (Plate LXIV, fig. 7) acutely conical, composed of ten segments, with four short tentacles at the apex. At the base posteriorly are two eyes, which in some are indistinct (spirit-preparations). Body about 3—4 ins. long, resembling that of *Goniada*, tapered anteriorly and also posteriorly, where it is flattened and terminates in two cirri (Plate LXIV, fig. 7*a*). The surface has the same glistening aspect as in *Goniada*. Of a pale pinkish or skin-colour in life.

Proboscis.—In this form none of the lateral V-shaped denticles are present. At the termination of the first region of the proboscis (in extrusion) is a row of papillæ (Levinsen shows eighteen), which are somewhat longer than those in *Goniada maculata*, and just within these are two larger denticles placed near each other, which show four hook-like teeth, two larger and two smaller. In the preparations, the arrangement of these seemed in some to differ from Malmgren's figure (Plate XI, fig. 64 B), which shows a decreasing series of four teeth in lateral view; whereas in some this was not evident (Plate LXIV, figs. 7 *b'* and 7 *b''*). The smaller denticles appear to number from twenty-two to twenty-four, and have two prominent teeth superiorly—most having thus a bifid aspect —and a trifid plate inferiorly, an aperture on each side occurring at this point (Plate LXIV, fig. 7 *b*). Levinsen (1893) gives a detailed account of the armature of the proboscis with figures of the paragnathi, and these structures seem to differ from those of the British form, which shows comparatively few paragnathi along the wall of the organ.

The first feet are simple and short, bifid and then trifid as they increase in length, and provided with short compound bristles. At the tenth foot three long lanceolate lobes occur (Plate LXXV, fig. 13), an upper, a median, and a lower. The translucent compound bristles stretch like a fan on each side of the tip of the median lobe, the longest tips being in the centre of the group, and they diminish on each side (superiorly and inferiorly).

The thirtieth foot (Plate LXXV, fig. 13 *a*) has still only three divisions, but they are more massive than at the tenth, and they are considerably flattened. The two groups of compound bristles differ, since one (the upper) has the most conspicuously elongated tips (Plate LXXXV, fig. 2 *b*). The single spine is powerful. Between the thirtieth and fiftieth feet the appendage attains greater complexity, the sixtieth (Plate LXXV, fig. 13 *b*) presenting a dorsal division of two lobes, a spine, and a few bristles, but these are often included in the tissues. This condition is evidently due to the growth of a dorsal lobe on the upper process of the trifid foot, which the spine of the division enters. The lower division of the foot consists of an upper long, bluntly conical

setigerous region with two fan-like groups of compound bristles, which are arranged in three divisions, an upper series of five or six with comparatively short tips, a second and larger series with longer, finely tapered tips, and a ventral series with long tips dorsally, shorter ventrally.

A great increase in the lamella at the inferior setigerous lobe occurs at the seventieth foot, so that in outline the parts are broadly lanceolate. The bristles are longer, more slender, and the terminal pieces finely tapered. The lobe also extends much further beyond the ventral lobe than in the fiftieth foot. The characteristic bristles (Plate LXXXV, figs. 2 and 2 *a*) now project from the lower superior lobe, it and the upper having a broadly conical outline.

A considerable change occurs at the one hundredth foot, for the lower lobe now far exceeds the superior in bulk, the broadly lanceolate outline being due to the approximation of the two flaps. The upper and lower bristles have shorter tips, the intermediate have very attenuate tips. The ventral cirrus is proportionally smaller. In the superior division, again, the setigerous lobe has assumed the form of a short and broad cone (Plate LXXV, fig. 13 *c*), with the bristles projecting freely. The dorsal lobe is small. The great length and slenderness of the tips of the ventral bristles posteriorly is a feature of note (Plate LXXXV, fig. 2 *c*).

The foot retains, with modifications, the structure just mentioned to the posterior end, the characteristic dorsal bristles projecting still more prominently, and with a distinct curve below the hook at the tip, which has a delicate process (Plate LXXXV, fig. 2 *b*).

A change in the length of the foot occurs about the sixty-fifth segment, for thereafter it becomes considerably longer, and remains so proportionally to the posterior end.

Reproduction.—In an example dredged in Bressay Sound in July, the body was filled with advanced ova. In the same month another of small size (1½ in.) dredged in 110 fathoms off the Blasquet, S.W. Ireland, had well-developed ova. Large ova also were present at the beginning of the same month in an example of average size from Balta (fifty fathoms). Another at St. Andrews on 16th June had numerous large ova in the cœlomic space.

It is remarkable to find such slight differences between the *Glycinde trifida* of the 'Challenger'[1] from Queen Charlotte Sound, near Long Island, New Zealand, and the British form.

Verrill's *Eone gracilis* from Vinyard Sound[2] does not seem, so far as the description goes, to differ materially from the foregoing.

Family XIII.—Glyceridæ.

Head long, in the form of a pointed ringed cone, with four small tentacles at the tip, and having a central space communicating with the body-cavity. Several authors state that "at the base of the snout are a pair of palps," and Ehlers observes that they are retractile. Body elongated, rounded, slightly tapered towards the head, and more

[1] Op. cit., p. 341.

[2] 'U. S. Comm. F. and F.,' 1873, p. 596, 1873.

distinctly diminishing toward the tail, which terminates in two short cirri. The segments are narrow, and have two or more rings. Feet with two divisions—a dorsal and a ventral, or with the latter only. Bristles of two kinds, viz., simple dorsal bristles with a narrow wing and serrated edge, and compound bristles, with the tips of the shafts dilated and split for the tapering serrated terminal piece.

Proboscis[1] powerfully muscular, with the first region easily protrusible, massive, glandular, with four hooked teeth which have a bifid or simple basal spur, and the pairs of which can cross each other vertically. Glands occur at the base. Alimentary canal simple.

Blood-vessels present or absent. The cœlomic corpuscles are large and tinted reddish, and move with special activity at the ciliated bases of the feet. These corpuscles contain hæmoglobin.[2]

The body-wall in the Glyceridæ (Fig. 90) is distinguished by its firmness and

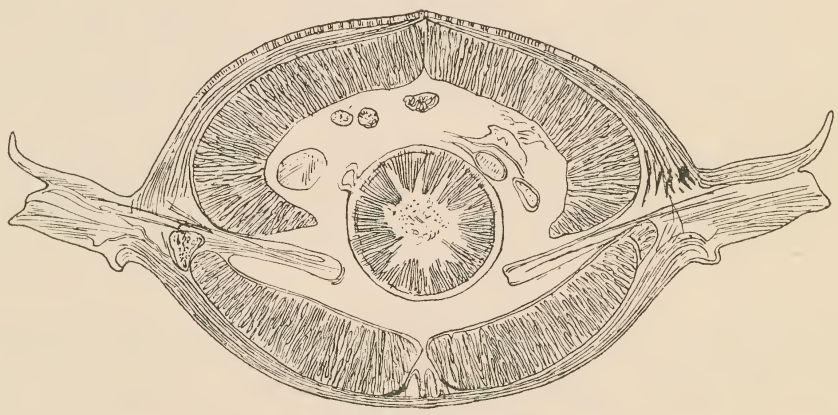


Fig. 90.—Transverse section about the anterior third of *Glycera lapidum*. Enlarged.

muscularity. The cuticle is fairly thick, and is tough. Beneath is a hypoderm of moderate depth, with numerous nuclei, which stain deeply, and areolæ—lined internally by a thin basement-tissue. The circular muscular coat is of exceptional thickness. It diminishes (in transverse section) almost to a few fibres in the mid-dorsal line (where the hypoderm is thicker), whilst ventrally, on each side of the nerve-area, it is also thin, the space being considerably broader than that in the mid-dorsal line. A narrow belt of circular fibres crosses this area ventrally to the other side, but very few turn upward to clasp the inner ends of the ventral longitudinal muscles. The dorsal longitudinal muscles are massive, separated by a gap in the middle line, and with a well-marked lobe curved inward ventrally to a blunt point. They cover a proportionally greater area than the ventral muscles, which form a long and slightly fusiform mass on each side, and meet over the nerve-cords in the middle line as they lie in a triangular area of their neuroglia—broad externally and pointed internally. Each cord has a neural canal of moderate size at its upper third near the middle line. It is doubtful, however, if in any respect such appears "to have generally the

[1] *Vide* Jourdan, 'C. R. Ac. Sc.,' t. cxii, p. 882.

[2] Ray Lankester, 'Proc. Roy. Soc.,' No. 140, 1873, p. 3 (sep. copy).

same relations as have the muscles and neural sheath, including the notochord, of a vertebrate."[1] The alimentary canal has a powerful layer of longitudinal muscles externally, and in some species (*e.g.*, *G. lapidum*) this layer holds two large vessels (dorsal and ventral).

Gills absent or present, sometimes retractile. The large nerve-cords (*e.g.*, in *G. lapi-*

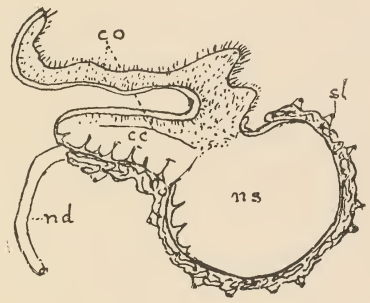


Fig. 91.—Diagrammatic reconstruction of the nephridial complex of *Glycera siphonostoma*, showing the nephridial sac (empty), the ciliated organ, and the nephridium. *co.* Ciliated organ. *ns.* Nephridial sac. *sl.* Solenocytes. *cc.* Chambered cæcum. *nd.* Nephridial duct. (Goodrich.)

dum, Fig. 90) are wedged in a hypodermic area between the large ventral muscles, which touch at their dorsal edges so as to form an arch over the nerves. The external circular muscular layer ceases before reaching the nerve-area, so that externally are only hypoderm and the specially thickened cuticle. The oblique muscles, attached above the cords, are slightly developed. Segmental organs (Fig. 91) blind internally, opening by a

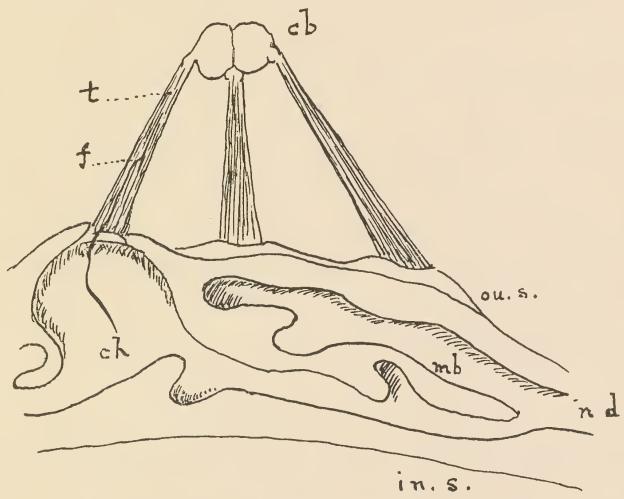


Fig. 92.—Diagrammatic reconstruction of a portion of the nephridium of *Glycera siphonostoma*, cut so as to show the course of the canals. The inner surface would be applied to the wall of the nephridial sac. *cb.* Cell-body (solenocyte). *mb.* Main branch. *f.* Flagellum, continued into the chamber. *t.* Tube with cilium in it. *nd.* Nephridial duct. *ch.* Chamber. *ou. s.* Outer surface. *in. s.* Inner surface. (Goodrich.)

pore on the ventral surface. Canal, which branches, passes inward and forward through the next septum to the genital funnel, which is known to accumulate waste products, and then spreads over the nephridial sac (or pouch of cœlomic epithelium). Solenocytes arranged in small groups (Goodrich). Exit of genital products not known.

[1] Ray Lankester, 'Ann. Nat. Hist.,' ser. 4, vol. xi, p. 92.

Grube's[1] seventh family, Glycerea, held both Glycera and Goniada, and he pointed out the correspondence of the proboscides of these with those of the Nephthydidæ and Phyllodocidæ.

Levinsen (1883) places the Glyceridæ as the second family of his Euniciformia Glycerina, the second division of the Euniciformia. Benham includes the family under his Nereidiformia.

Gravier[2] is of opinion that the rings of the prostomium in this group are superficial and only affect the epidermis, and thus they correspond with the condition in other annelids.

Goodrich[3] holds that Ehlers misinterpreted the exact structure of the segmental organs (Figs. 91 and 92) in *Glycera*—which consist of a segmental organ, the ciliated organ, and a segmental sac. The organ opens to the exterior by a minute pore outside the large bundles of ventral longitudinal muscles. The pore leads to a slender canal which passes through the body-wall to the septum, pierces it, and joins the segmental sac. He thinks the ciliated organ and sac gather up through phagocytes the waste products in the cœlom (with which there is no direct communication), whilst the purpose of the segmental organ is to eliminate solid excretory matter from the cœlomic fluid. The function of the solenocytes is possibly analogous to the Malpighian capsules of vertebrates, viz., to excrete liquid. Fage[4] terms the ciliated organ the cilio-phagocyte organ, and it is always attached to the nephridium. The nephridial mass in close contact with the ciliated organ is divided into a multitude of minute canals, and the surface is hirsute with a peculiar form of solenocyte. The organ, which is globular in shape, is remarkably developed in *Glycera siphonostoma*, and in section it is elaborately reticulated. The ciliated organ is a simple fold of the peritoneal epithelium which covers the dissepiment. In *Glycera alba*, H. Rathke, the nephridial mass forms three lobes, each with solenocytes. It is held that the segmental organ does not transmit the genital products.

Dr. Thomas Williams (1852) pointed out the nature of what he called the "chyl-aqueous fluid" in *Glycera alba*, and mentioned that in this form cilia occurred internally at the base of the feet. He combated the opinion of De Quatrefages that the perivisceral fluid was always circulated by vibratile cilia. He states that the cœlomic fluid is colourless, but that the corpuscles are blood-red, whereas "the *true blood* conforms with the annelidan law of perfect fluidity: it bears no visible elements, and is light red in colour."

Kinberg[5] termed the upper tentacles "antennæ," the lower "palpi." He distinguished for purposes of classification the lateral pharyngeal papillæ from the terminal (between and in front of teeth), and he separated his "ovaria" (=branchiæ, Aud. and Edw.; "Kiemen," Grube) from his branchiæ (=lingulæ), the modified terminal regions of the ventral cirri.

[1] 'Fam. Annel.,' p. 59, 1851.

[2] 'C. R. Ac. Sc.,' t. cxxvi, p. 972, 1898.

[3] 'Quart. Journ. Micr. Sc.,' vol. 41, pp. 439—457; and 'Internat. Congress Zool.,' Cambridge, 1899, p. 196.

[4] Ann. Sc. nat., 9e sér., t. iii, p. 297, 1906.

[5] 'Öfvers. af. k. Vet.-Akad. Förh.,' No. 2, p. 244, 1865.

De Quatrefages (1865) described a dorsal and a ventral-blood vessel accompanying the intestine in the Glyceridæ, though he also noted that the reddish fluid accumulated in irregular places, and that in some the circulation was diffuse. He distinguished the genera by the uniramous or biramous feet, and their nature.

Ehlers (1868) divides the Glyceridæ into two great groups, according to the structure of the feet. In the first the foot has two anterior but only a single posterior lobe, and under this section fall two forms, viz., *Glycera capitata* and the British *Glycera lapidum*, De Quatrefages. The other British forms are included under the second division, viz., those in which two anterior and two posterior lobes are present. This division has three sections. In the first the anterior lobes are long, whilst the posterior are either truncated or rounded or very slightly pointed. Of those devoid of branchiæ is a British representative, viz., *Glycera siphonostoma*. In the second section in which the two anterior lobes of the foot are long, whilst one of the posterior lobes is longer than the other and with simple branchiæ, is the well-known *Glycera alba*, H. Rathke. In the third section, comprising forms in which the anterior lobes of the foot are long and the two posterior somewhat long, and with simple dorsal branchiæ, is *G. albicans*, De Quatrefages.

Ehlers unites *Goniada* with *Glycera*, and there is much to be said in favour of this view, and comparatively little against it. He groups the Glyceridæ thus :

A. Proboscis with four hook-like jaws issuing from glandular sacs. Foot in all the segments well formed (uniform) :—*Glycera tetragnatha*.

1. Foot simple (of one division) with only a single spine and a bundle of jointed bristles.
   Hemipodus, De Quatrefages.
2. Foot with two divisions, two groups of bristles, and two spines.
   Glycera (Sav.).

B. Proboscis with several irregularly formed teeth, without glandular sacs. Anterior and posterior feet unlike (ungleich) :—*Glycera polygnatha*.
Goniada and *Eone*.

Claparède (1868) observes that the perivisceral cavity in *Glycera* is divided into two by muscular floors. In the majority of the Annelida Errantia it is divided into three longitudinal chambers. He was of opinion that this family (Glyceriens, Grube) may best be divided into two genera, the one *Glycera*, like Savigny's original species *G. unicornis*, being devoid of teeth, the other, *Rhynchobolus*, having them.

The blood-system is reduced, but Wirén found blood-vessels in *Glycera alba*, and Arwidsson[1] in this, in *G. Goesi*, *G. siphonostoma*, and *G. capitata*.

Ray Lankester again met with hæmoglobin in the perivisceral corpuscles of *Glycera* (species not stated) at Naples.[2] This subject has been investigated by Cuénot,[3] Goodrich,[4] and Kollmann.[5] Goodrich found leucocytes and granular cells besides the corpuscles

[1] 'Bih. k. Sv. Vet.-Akad. Handl.,' Bd. xxiii, 1897.
[2] 'Proc. Roy. Soc.,' No. 140, 1873, p. 3 (sep. copy).
[3] 'Arch. Zool. expér.,' 2e sér., t. v, Suppl. 2, 1873.
[4] 'Quart. Journ. Micr. Sc.,' vol. 43.
[5] 'Ann. Sc. nat.,' 9e sér., t. viii, p. 147.

containing hæmoglobin, which were regular in form in *Glycera siphonostoma*. Similar results were attained by Kollmann, who further found the corpuscles containing hæmoglobin dividing karyokinetically in *Glycera convoluta*.

Grube, in 1870, thus groups the Glyceridæ:

1. Glyceridæ with branchiæ.

A. Branchiæ of the upper edge of the foot situated near the tip—a simple or clavate process. The two anterior lamellæ of the foot elongated.

(*a*) The upper posterior lobe resembling the anterior, the inferior shorter. Branchiæ simple.

G. alba, H. Rathke; *G. convoluta*, Kef.

B. Both hind lobes short and blunt; only a small papilla present.

Foreign species.

C. Branchiæ situated on the anterior border of the foot.

(*a*) Branchiæ simple.

G. fallax, De Quatref.

(*b*) Somewhat forked, simple; lobes triangular, the anterior longer.

G. unicornis.

(*c*) Branchiæ branched.

Foreign sp., *e. g.*, *G. dibranchiata* (Massachusetts Bay).

2. Glyceridæ without branchiæ.

A. Foot with two anterior lobes, and only one broad posterior lobe.

G. capitata.

G. gigantea (= *G. siphonostoma*, D. Ch.), De Quatref. Anterior segments longer than the rest, the middle third as broad as long. Body 1 foot long, 300 segments. Anterior lip of foot with blunt tip; posterior upper lip short, triangular, the inferior less, shorter, bluntly rounded. Papillæ of proboscis digit-like, blunt.

G. decorata, De Quatref. Foot similar, anterior lip pointed, hind lip short and high, anterior segments shorter than in *G. gigantea*. Papillæ of proboscis fringe-like, oval, or clubbed.

Grube (1878) characterizes the family Glycerea (Gr.) as having a conical head-lobe of many annuli. Tentacles and subtentacles two, short; sometimes none, often two obtuse short tentacular organs posteriorly; no eyes. Body long or short, vermiform, rounded, with numerous biannulate segments; two anal cirri. No blood-vessels.

Buccal segments several; the first long, naked, the rest bear feet. Proboscis clavate or sub-cylindrical, with minute papillæ, often with a circle of larger ones at the orifice. Jaws two or four, sometimes with intermediate paragnathi, anterior and basilar. Branchiæ fixed to walls of pinnæ, often retractile, simple sacs or bifurcate, rarely ramose, or none. Feet uni- or biramous, with dorsal and ventral cirri, the former minute, papilliform, inserted above the base of the foot. Bristles simple and compound.

A careful account of the proboscis of *Glycera convoluta*, Kef., was given by C. Gravier

in 1898. He divides the structure into three regions—the anterior or pharyngeal, the middle or proboscis (trompe pharyngienne), and the posterior region or ventricula (stomach). From the structure of the teeth this would appear to be *G. capitata*. The great development of the nervous system of the proboscis is emphasized.

This author further adds that *Glycera* has transverse bands of cilia on the segments of body and head. He figures and describes a nuchal organ on each side of the basal cephalic segment. A longitudinal groove occurs on the prostomium ventrally. Gravier concludes that the head of a Polychæte differs fundamentally from a normal metamere.

Viguier[1] again considers all in front of the mouth as the prostomium.

In regard to distribution, none were found beyond 470 fathoms in the 'Challenger,' but Ehlers mentions *Glycera capitata* at 664 fathoms in the 'Porcupine.' *Hemipodus* has not hitherto occurred in British waters; as a rule it is southern and abounds in the Strait of Magellan ('Challenger'). It is probable that most of the European forms stretch to the American shores, and that further study will simplify the present list of species.

Genus LXXVI.—Glycera, *Savigny*, 1820.

Head acutely conical with eight or more rings. Buccal (peristomial) segment large. Eyes absent or present; two retractile palpi (Ehlers). Segments with two or three rings. Feet bifid; a dorsal division with a stumpy dorsal cirrus often above the foot and simple bristles with very narrow serrated wings, and a ventral with compound bristles and a flattened ventral cirrus. Ventral spine considerably longer than the dorsal. Branchiæ present or absent. A modified blood-vascular system. Perivisceral corpuscles reddish. Proboscis large, powerful, with four black teeth, the tips of which are strongly hooked and emerge from a follicle with large glands. Muscular layers, nerve-cords, and segmental organs as in the type.

Kinberg (1865), in his characters of the genus, placed reliance on the structure of the teeth (his maxillæ), which he described as having a long and a short lateral process, whilst the "branchiæ" were terminal, and stated that with the ventral cirrus there were generally five lobes on the feet. He did not enter into the minute characters of the bristles. *Glycera* and *Hemipodia* were his two genera.

Group I.

No branchiæ.

1. Glycera lapidum, *De Quatrefages*, 1843. Plate LV, fig. 4; Plate LXIV, figs. 9[2] and 9 *a*; Plate LXXVI, figs. 1–1 *b*—feet, etc.; Plate LXXXV, figs. 3–3 *b*—bristles.

Specific Characters.—Head a moderately elongated cone of eight segments. Body elongated (3—4 ins.), and of 150—170 segments, which are three-ringed, the median in spirit-preparations being more elevated than the others. It terminates posteriorly in two

[1] 'Annel. Infer. Bay of Algiers.'

[2] This is termed *G. capitata* in the explanation.

small cirri. Colour yellowish-white or in some slightly pinkish. Proboscis clavate, with a rich covering of filiform papillæ with crenated edges, four blackish-brown teeth hooked at the tip and also thinned off at the other end, and with a bifid spur at one side. The foot has a single spine in front, but about the thirty-fifth the dorsal lobe, instead of being folded backward, projects straight outward, and dorsal bristles are present, though the second spine only appears about the forty-fifth foot. The typical foot presents three pointed lobes and a small dorsal cirrus above it, the third or inferior lobe, which Ehlers says is larger, being the conical ventral cirrus, whilst the hind lip is broad and rounded. The ventral bristles (compound) are in two groups and fan-like in arrangement; moreover, the extreme dorsal and ventral bristles are stronger than the central in the posterior region of the body.

In the epitocous form the body is longer, the feet are longer and more prominent, and the spines and bristles longer and more attenuate.

Synonyms.

1845. *Glycera alba,* Johnston. Ann. Nat. Hist., xv, p. 147, pl. ix, f. 1—10.
1851. „ „ Williams. Rep. Brit. Assoc., 1851, p. 172, pl. ii, f. 5, and p. 235, pl. xi, f. 61.
1853. *Nereis teres,* Dalyell. Pow. Creat., ii, p. 144, pl. xx, f. 1 and 2.
„ „ *doreæ,* Leach. In Brit. Mus. Coll. (*fide* Johnston).
1862. (?) *Glycera capitata,* Keferstein. Zeitschr. f. wiss. Zool., Bd. xii, p. 105.
1864. *Glycera alba,* Grube. Insel Lussin, p. 83.
1865. „ „ Carrington. Annel. Southport, p. 7.
„ „ *capitata* (olim *alba*), Johnston. Cat. Worms Brit. Mus., p. 186, pl. xv *b*, f. 1—10.
„ „ „ Baird. Ibid., p. 342.
„ „ *lapidum,* De Quatrefages. Annel., ii, p. 187.
1867. „ *alba,* Parfitt. Trans. Devon. Assoc., ii, p. 26 (sep. copy).
1868. „ *lapidum,* Ehlers. Borstenw., ii, p. 652.
1874. „ *capitata,* McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 200.
„ „ „ Malm. Göteb. vet. o. vitt. Handl., xiv, p. 86.
1875. „ „ McIntosh. Invert. and Fishes St. Andrews, p. 124.
1878. „ „ idem. Trans. Linn. Soc., Zool., i, p. 503.
1879. „ „ Hansen. Nyt Mag. f. Naturvid., xxiv, p. 268.
1883. „ „ Levinsen. Vidensk. Meddel. Foren. Kjöbenh., p. 219.
1885. „ „ McIntosh. 'Challenger' Annel., p. 343.
„ „ „ Carus. Fauna Medit., p. 224.
1891. „ „ Hornel. Trans. Biol. Soc. Liverp., vol. v, p. 244.
1894. „ „ De St. Joseph. Ann. Sc. nat., 7e sér., t. xvii, p. 31, pl. ii, f. 39—42.
1896. „ *lapidum,* Michaelsen. Polych. deutsch. Meere, p. 27.
1898. „ „ Arwidsson. Bergens Mus. Aarb., xi, p. 15, pl. i, f. 7 and 8; pl. iv, f. 55.
1905. „ „ McIntosh. Ann. Nat. Hist., ser. 7, vol. xv, pp. 39 and 50.

Forma epitoca.

1865. *Glycera setosa,* Johnston. Cat. Worms Brit. Mus., p. 342.
1876. „ „ McIntosh. Proc. Roy. Soc., xxv, p. 217.
1879. „ „ Hansen. Nyt Mag. f. Naturvid., xxiv, p. 269.
1883. „ „ Levinsen. Vidensk. Meddel. Foren. Kjöbenh., p. 219.

Habitat.—St. Andrews Bay, three to four fathoms and between tide-marks in fissures of rocks amidst sandy mud; nine miles off Balta, fifty to sixty fathoms, J. G. Jeffreys, 1868; four to eight fathoms, Bressay Sound, Shetland; dredged south of Sark (epitocous male). Polperro, on gravel (Dr. Baird). Lamlash Bay (Dr. Howden). Coast of Cornwall, twenty to twenty-three fathoms. In fifty fathoms Dingle Bay; off Bundoran, Donegal Bay, twenty to thirty-five fathoms, 'Porcupine,' 1869. In muddy sand at Station III, 'Porcupine,' 1870, Lat. 48° 31′ N., Long. 11° 3′ W., in 690 and 500 fathoms. Stomachs of cod and haddock, St. Andrews (E. M.). Scottish Fishery Board, Station LXVI. Trawled off Sark by Col. Fraser and Capt. Powell; thirty to fifty miles west of Valentia, Ireland, in 90—125 fathoms (J. G. J.); fifty-three fathoms, 'Knight Errant,' 3rd and 4th August, 1880, Station III; 664 fathoms in the 'Porcupine' (Ehlers).

Off Bergen, Norway (Canon Norman). In clayey mud in the Norwegian Fjords, where O. F. Müller early procured it. As *G. setosa*, surface of sea in Waigat Strait, 'Valorous' Expedition. Station III, 'Valorous,' twenty fathoms, shell-sand, 1875. 'Valorous,' 1100 fathoms, 1875, Station VI. Shores of the North Atlantic. West coast of North America (Ehlers). Off Fayal, Azores. Off Setubal. Mediterranean in 'Porcupine' Expedition of 1870, at Station XVII *a* in 795 fathoms, and thirty miles W. of Cape Mondays, 100 fathoms; and at Station 50, Lat. 36° 14′ N., Long. 17° 30′ E., seven to fifty-one fathoms. Mud and muddy sand, Bono Bay, twenty-five fathoms. On a sandy bottom at Station XXX, in 386 fathoms, and with a bottom temperature of 53°, and in forty-five fathoms eight miles N.W. of Cape Sagres, 'Porcupine,' 1870.

Head with a tapering series of about eight segments, the terminal having four slender tentacles. No sign of retractile palpi.

Body 3—4 ins. long, 150—170 segments (Ehlers), slightly tapered anteriorly, and more distinctly so posteriorly, rounded on the dorsal and somewhat flattened on the ventral surface, diminishing to a slender tail, and terminating posteriorly in two small cirri. Each segment has three distinct rings, the median being more elevated than the anterior and posterior. In section, besides the neural canals at the upper border of each nerve several smaller (branches) exist near the middle line below it. Groups of nuclei occur in the sheath, especially externally. The cords lie at the outer border of the area. The apex of the triangular nerve-area is occupied between the ganglia by a fibrillar neurilemma with nuclei externally.

Colour of a small example translucent yellowish-white, opaque along the gut. Ventrally the double nerve-cord is visible through the skin, and is pinkish anteriorly, where it is dilated, and a pink patch also appears both dorsally and ventrally in front of the ganglia. The nerve-cord is pale posteriorly. The four black jaws are seen through the transparent skin. The intestinal canal is straight—pale behind the jaws and dilated for some distance, then brownish to the tail. The lines of the segments have a clear patch on each side. Some are slightly pinkish.

Internally active ciliary motion at the base of the feet, probably in connection with the segmental organ, and it did not extend into the foot. The peritoneal corpuscles have projecting processes like a bread-fruit. In section the gut has a thick layer of longitudinal muscular fibres under the peritoneal or cœlomic investment, and this

coat clasps two vessels at opposite poles, the contents of these being coagulable and staining deeply. The circular muscular coat follows, and then the dense epithelial coat internally.

The proboscis in extrusion forms a long clavate organ, richly papillose, the individual papillæ being filiform (Plate LXXVI, fig. 1 *a*) with crenated edges. At the termination of the first region are four blackish-brown teeth, each consisting of an elongated portion hooked at the sharp tip, and also thinned off at the other end, where its muscles of attachment are. On one side is a spur which becomes bifid after a short distance, and to it other muscles are fixed. In the ordinary position in extrusion the four teeth are at the angles of a square, and the long spur is vertical, the shorter passing inward obliquely from each angle. The axis of the hooked tooth is nearly transverse. The aperture of the proboscis is also transverse and in the centre. A symmetrical arrangement of the muscular fibres further gives a character to the truncated terminal region at the teeth. When the organ by a rupture of the body-wall is thrust out in its unrolled position, the first region is marked by a series of longitudinal striæ with the villi internally. At the end is a ring of long processes like ruptured muscular fasciculi, beyond which the four thick muscular masses for the teeth occur, followed by a somewhat clavate part with ridges internally, and containing food. Such probably represents a gizzard. A constriction separates this from the head-region, which at its commencement has a series of strong muscular bands for retraction.

So far as can be observed the first foot has three anterior lobes and a large rounded posterior lobe. The dorsal is the most slender, the median next, and the ventral is much broader, its outline being lanceolate. The posterior lobe is bluntly rounded. The dorsal bristles are comparatively short and finely tapered. The ventral spread out like a fan above and below the spine. The differences between the outer and central bristles of the fan are slight.

At the tenth foot (Plate LXXVI, fig. 1) the bristles are longer, but only one spine occurs. The median lobe or papilla is longer. The change in the condition of the foot occurs about the thirty-fifth, and is often recognized by the fact that the dorsal lobe, instead of being folded backward, stands straight outward. The dorsal bristles are now present (Plate LXXXV, fig. 3), but only a single spine, the second appearing about the forty-fifth, though variation probably exists. The form remains similar at the fiftieth foot, but the upper and lower compound bristles (Plate LXXXV, fig. 3 *b*) are thicker or stronger than the median (Plate LXXXV, fig. 3 *a*), a feature still more marked at the ninetieth foot (Plate LXXVI, fig. 1 *b*). The pointed condition of the three lobes is a marked feature, and all are more or less anterior, though the ventral lobe is generally sloped backward. The only posterior lobe is the bluntly rounded one behind the bristles. A single spine supports the foot, the simple dorsal bristles passing from the spine toward the dorsal papilla or lobe. At the base of the foot superiorly is the short papilla on the side of the body. The differentiation of the ventral bristles into a diminishing series from each edge is noteworthy. The foot appears to remain constant in its parts from the anterior to the posterior end.

Reproduction.—Specimens procured in Bressay Sound in July were laden with nearly ripe ova. Dalyell's example spawned in July.

Habits.—This species frequents sandy gravel and mud (Shetland). Dr. Johnston found his under stones and buried in gravel or sand, not far below the surface, and, as mentioned, it sometimes occurs between tide-marks in fissures of sandstone.

In the epitocous form (*G. setosa*) the body becomes more elongate and attenuate and the feet are more prominent and longer—with attenuate bristles—which with the foot give a character to the form. Two specimens procured in the 'Valorous' were males. In these both spines and bristles become greatly elongated, but the latter retain their essential structure. The example from eight fathoms in Bressay Sound seemed also to be a male. It was much smaller than the foregoing.

This would appear to be the species referred to by O. F. Müller (1788) as *Nereis alba*, judging from his description and figures.

Malmgren (1867) included under *G. capitata* both the northern type of Œrsted and the southern *G. lapidum*, making its sexual form, *G. setosa*, a separate species.

Ehlers (1868) showed that Œrsted's *Glycera setosa*, and Johnston's *G. alba*, as well as the *G. lapidum* and *G. Mülleri* of De Quatrefages, all pertained to this species.

In Verrill's Check List for the U.S. Commission (1879) *Rhynchobolus albus, capitatus*, and *dibranchiatus* appear.

2. Glycera Ehlersi, *Arwidsson*, 1898. Plate LXXXVI, figs. 4, 4′, and 4 *a*—bristles; Plate LXXXVII, fig. 6—foot.

Specific Characters.—Head very long, attenuate, of more than twenty rings, muscles separated by a median streak. Body elongated for a *Glycera*, segments two-ringed; dorsal surface rounded and marked by a slight median groove. The ventral surface has a median ridge flanked by a groove at each side. Proboscis with rather long digit-like papillæ[1] slightly tapered towards the tip. Jaws with a powerful curved main fang having a broad base with two long spurs. Foot has the dorsal cirrus unusually large, two long papillæ or lobes close to each other and almost parallel anteriorly, and a single flattened lobe with a rounded edge posteriorly. Ventral cirrus short and conical, its tip nearly in a line with the edge of the posterior lobe.

Synonyms.

1868. *Glycera lapidum,* Ehlers. Borstenw., ii, p. 652.
1898. „ *Ehlersii,* Arwidsson. Bergens Mus. Aarb., No. xi, p. 19.
1905. „ „ McIntosh. Ann. Nat. Hist., ser. 7, vol. xv, p. 41.

Habitat.—Eighty fathoms, St. Magnus Bay, 1867. Nine miles off Balta, fifty to sixty fathoms, 1868 (Dr. J. G. Jeffreys). Fifty-three fathoms, Station III, 'Knight Errant,' 3rd and 4th August, 1880.

Shores of France (St. Malo).

[1] Grube describes them as short and leaf-like. He apparently thinks this like *G. capitata,* but with the anterior lobes of the foot longer, and the segments two-ringed.

Head long, attenuate, composed of numerous (apparently twenty-two) rings, with the four minute tentacles at the tip, and two longer dorsal and two shorter a little below (palpi of Ehlers). In the preparations the muscles of the snout are separated by a median longitudinal streak.

Body rather small, about three inches in length, tapering a little anteriorly, and much more gradually posteriorly. The dorsal surface is rounded and marked by a slight median groove. The ventral has a median ridge flanked by a groove at each side. The segments are two ringed. The proboscis has rather long simple digit-like papillæ slightly tapered towards the tip.[1] The black jaws have a powerful, curved fang, and a broad base which has two spurs, so that it is triradiate, but it is difficult to remove them uninjured from the muscles.

The typical foot (Plate LXXXVII, fig. 6) has a large dorsal cirrus at the base superiorly, two well-marked pointed lobes near to and almost parallel with each other anteriorly, and only a single short and rather deep lobe posteriorly. The ventral cirrus forms a short conical lobe which does not project so far outward as the anterior lobes, the tip, indeed, being in a line with the edge of the posterior lobe. Two spines are present.

The dorsal bristles (Plate LXXXVI, fig. 4) are simple and long, with a slight forward and then a backward curvature as the tip flattens before tapering to a delicate tip. The ventral bristles (Plate LXXXVI, fig. 4 *a*) have a similar curvature of the shaft which slightly enlarges, then is narrow below the expanded distal end, which is split for articulating with the flattened and finely tapered terminal blade. One bristle near the dorsal edge of the ventral fascicle is somewhat larger than those near it.

3. Glycera siphonostoma, *Delle Chiaje*, 1825. Plate LXIV, figs. 8, 8 *a*—proboscis and tail; Plate LXXVI, figs. 2–2 *c*—feet; Plate LXXXV, figs. 4–4 *b*—bristles.

Specific Characters.—Head a conical process of nine segments.[2] Body rounded, upward of a foot long and half an inch in diameter, slightly tapered anteriorly, more distinctly so posteriorly, where it terminates in two cirri. Segments two-ringed. Colour pinkish or pale skin colour, with a reddish patch from the brain, and a pale brownish gut posteriorly. Proboscis massive—with four powerful black hook-like teeth. Papillæ lanceolate and streaked like a leaf.[3] Foot comparatively short, with an ovoid dorsal cirrus at its base; two long anterior broadly lanceolate papillæ or lobes about equal in length; and two short blunt posterior lobes besides the ventral cirrus, which is of considerable length and has the tip pointed, but it does not extend so far outward as the anterior lobes. The nerve-cords are surrounded by a thick sheath of the neuroglia, to the investment of which the muscular fibres are attached. Numerous nuclei and cells more immediately surrounding the cords in the interganglionic areas stain deeply. The sections would seem to show that the cords are circular in the interganglionic and

[1] Ehlers says they are leaf-like.

[2] Grube states that each ring bears minute processes (Härchen), probably palpocils.

[3] Grube describes them as stiff and thread-like.

elongate-ovoid in the ganglionic area, where their vertical diameter is considerably increased. Segmental organs as described (p. 473).

Synonyms.

1825. *Lumbricus siphonostoma,* Delle Chiaje. Mem., ii, pp. 413—428, Tav. xxviii (2), f. 20—24.
„ *Nereis* (*Glycera*) *dubia,* De Blainville. Dict. Sc. Nat., xxxiv, p. 451.
1827. „ *alba,* Bruguière. Encycl. Méth., Vers, i, p. 134, Tab. lvi, f. 21, 22.
1828. *Glycera dubia,* Blainville. Dict. Sc. Nat., lvii, p. 483, Tab. xix, f. 1.
1841. „ *syphonostoma,* Delle Chiaje. Descriz. e not., iii, p. 84, v, p. 98, Tav. ci, f. 21—24.
„ *Lumbricus siphonostoma,* idem. Ibid., Tav. ci, f. 21—24 (descrip. Plate).
1853. (?) *Nereis* (*Nephthys*) *hirsuta,* Dalyell. Pow. Creator, ii, p. 145, pl. xxi, f. 1—3.
1862. *Glycera convoluta,* Keferstein. Zeitschr. f. wiss. Zool. (partim), *fide* Claparède.
1863. „ *tessellata,* Grube. Arch. f. Naturges., Jahrg. xxix, p. 41, Taf. iv, f. 4.
1864. „ „ idem. Insel Lussin, p. 83.
1865. „ *dubia,* De Quatrefages. Annel., ii, p. 179.
„ „ *gigantea,* idem. Ibid., p. 183.
„ „ *decorata,* De Quatrefages. Annel., ii, p. 181.
„ „ *tessellata,* idem. Ibid., p. 190.
„ „ *siphonostoma,* idem. Ibid., p. 198.
„ „ *dubia,* Johnston. Cat. Worms Brit. Mus., pp. 185 and 342.
1867. „ „ Parfitt. Trans. Devon. Assoc., ii, p. 26 (sep. copy).
1868. „ *tessellata,* Ehlers. Borstenw., ii, p. 654, Taf. xxiv, f. 2, 33, and 34.
„ *Rhynchobolus siphonostoma,* Claparède. Annél. Nap., p. 182, pl. xvi, f. 2, et pl. xxxi, f. 5.
1870. *Glycera gigantea,* Grube. Jahr. Schles. Gesell., 1869, p. 56.
1874. „ *dubia,* McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 200.
1875. „ „ idem. Invert. and Fishes St. Andrews, p. 124.
„ „ *tessellata,* Marion and Bobretzky. Ann. Sc. nat., 6e sér., t. ii, p. 17.
1879. „ *dubia,* Langerhans. Zeitschr. f. wiss. Zool., xxxiii, p. 301, Taf. xvi, f. 36.
1881. „ *tessellata,* idem. Canar. Annel. in Nova Acta Leop.-Car., xlii, p. 113.
1885. „ „ McIntosh. 'Challenger' Annel., p. 343, pl. xlii, f. 5.
„ „ „ Carus. Fauna Medit., p. 224.
1891. „ *nigripes* and *dubia,* Hornel. Trans. Biol. Soc. Liverp., vol. v, p. 244.
1893. „ *tessellata,* Marenzeller. Zool. Ergebn., ii, p. 10.
1894. „ *gigantea,* De St. Joseph. Ann. Sc. nat., 7e sér.,[1] t. xvii, p. 22, pl. ii, f. 20—29.
1897. „ *siphonostoma,* Arwidsson. Bih. Sv. Vet.-Akad. Handl., Bd. xxiii, p. 21.
1901. „ *tesselata,* Treadwell. U.S. Comm. F. and F., p. 201.
1904. „ „ Moore. Proc. Acad. Nat. Sc. Philad., vol. x, p. 464.
„ „ *gigantea,* Allen. Journ. M. B. A., n.s., vol. vii, p. 226.
1905. „ *siphonostoma,* McIntosh. Ann. Nat. Hist., ser. 7, vol. xv, pp. 41, 50, 51, and 56.
1906. „ *tesselata,* De St. Joseph. Ann. Sc. nat., 9e sér., t. iii, p. 229.
„ „ *siphonostoma,* Eisig. Fauna u. Fl. Neap., xxviii, p. 236.

Habitat.—Tossed on the West Sands of St. Andrews after storms, and occasionally found in the sand at extreme low water (E. M.). Under stones on sand, between tide-marks, Guernsey and Herm. Dredged off the Hebrides, and in the Minch; in ninety-five fathoms off Balta; in eighty fathoms, St. Magnus Bay (J. G. Jeffreys, 1866). In muddy sand, four to eight fathoms, Lochmaddy, 1865 and 1872, as well as between tide-marks, in Loch

[1] By a misprint in the volume this has occasionally been entered as 8e sér.

Portan, near Lochmaddy, and at Paible. Scottish Fishery Board, Station LXVI, off Cromarty? Plymouth (Allen). Connemara (A. G. Moore). One hundred and ten fathoms, thirty miles west of the Blasquet, south-west Ireland, 'Porcupine,' 1870. East coast of England. Loch Goil (E. W. Hoyle, 1878).

'Porcupine,' 1870, off Cape Guardia. Shores of France. Shores of the Adriatic, Lussin Piccolo (Grube). Quarnero (Ehlers). Canada. Japan (Moore and self). Off Fayal in the Azores ('Challenger'). Madeira and Canaries (Langerhans). Off the Cape of Good Hope ('Challenger'). Porto Rico (Treadwell).

Head forming a conical process of thirteen segments.

Body in life upwards of a foot long and nearly half an inch in diameter, a little narrower anteriorly, and tapering more distinctly posteriorly. Each segment has two rings, that bearing the foot being somewhat broader as a rule. In good examples the surface of the body is thrown into a series of papillæ, especially laterally on the ridges of the segments, so that a tessellated aspect is given to the general surface, hence probably the origin of the name given by Grube.

Proboscis.—In the preparations this is a short, massive, clavate organ, having the four powerful black hook-like teeth at the tip. The inner surface of the organ is minutely papillose (Plate LXIV, fig. 8), each papilla being somewhat lanceolate in outline, and many are obliquely streaked. The teeth are only of use for seizure after the extrusion of the proboscis, which the animal ejects with much force. Claparède (1868) attributes the coloration of this organ to reddish granular pigment between the muscular fibres. He also observes that the perivisceral cavity is divided into two chambers by the union of the dorsal muscles below the intestine. The body terminates posteriorly in two short tapering cirri (Plate LXIV, fig. 8 *a*).

The nerve-cords occupy a similar position to those of *G. lapidum*, and the area has the same shape, and, as in that species, there are alternations in position according as the section passes through the ganglia or between them. Two upper and several subsidiary neural canals also are present.

The dorsum has a pinkish blush, marked in front by the whitish opacity of the retracted proboscis, and acquiring a very faint pale purplish hue posteriorly in contraction. Others have a uniform pale flesh-colour with a pale snout and a reddish patch (ganglia) at its base. Some are mottled pinkish white, with the black jaws visible through the integument, and a few are of a reddish flesh colour. A large example at Herm had a general purplish skin colour. Posteriorly the gut in the pale forms tints the central line brownish.

The first foot has a large conical and a smaller lobe, a single spine, and two tufts of bristles.

At the tenth foot (Plate LXXVI, fig. 2) three main divisions appear in lateral view, viz., a large digit-like dorsal, a smaller median, and a shorter ventral with a broad base, though posteriorly the setigerous process also shows two small elevations of its edge. The dorsal bristles are simple, translucent, tapered, with just a trace of a wing. The ventral are compound. Two spines are present. An ovoid papilla (dorsal cirrus) occurs on the body at the base of the foot superiorly, and is especially conspicuous anteriorly in this form.

The twentieth foot has two long conical papillæ anteriorly, and two flattened truncated lobes posteriorly, besides the dorsal cirrus and the shorter ventral cirrus.

The dorsal bristles (Plate LXXXV, fig. 4) are translucent, simple, with a slight forward curvature of the shaft below the tip which inclines a little backward and then forward at the finely tapered extremity. The edges of the tip present traces of wings.

The ventral bristles (Plate LXXXV, figs. 4 *a* and 4 *b*) have somewhat stouter shafts, also with a slight bend forward and then backward toward the dilated end, below which a slight constriction occurs. The dilated end of the shaft is split for articulation with the thickened base of the terminal blade, which then is flattened and gradually tapered to a fine point.

Both dorsal and ventral bristles extend beyond the anterior conical lobes.

The two anterior lobes have increased in size at the thirtieth foot (Plate LXXVI, fig. 2 *a*), and the bristles are proportionally longer. The ventral lobe is somewhat less. Little change occurs from the foregoing to the ninetieth foot, and indeed to the posterior end of the fragmentary examples. The bristles are arranged in two bundles in each division of the foot. The foot is therefore characterized by the two pointed anterior and the two blunt posterior lobes.

A typical foot, *e.g.*, the thirtieth, is comparatively short, and the dorsal cirrus is more closely connected with it than in some forms, so that in profile it is distinctly a part of the outline of the foot. The two anterior lobes are broadly lanceolate with pointed tips and are about the same length. The ventral lobe does not extend so far outward, but, as it arises near the base of the foot, it is of considerable length, and the tip is also pointed. The two posterior lobes form short blunt flaps. The characters of the foot remain more or less distinct to the posterior end, as, for instance, in the twentieth from the tip of the tail (Plate LXXVI, fig. 2 *b*).

In some forms, *e.g.*, that dredged by the 'Porcupine' off Cape Guardia, in 1870, the two anterior lobes are considerably elongated (Plate LXXVI, fig. 2 *c*).

The posterior portion of the body is readily reproduced, a provision which renders the frequent ruptures during its violent muscular exertions less serious (Plate LXIV, fig. 8 *a*).

Reproduction.—At Naples Lo Bianco[1] found this form mature from December to April.

Habits.—They are active animals, progressing through the water with a wriggling screw-motion—probably as they do through wet sand. When irritated the proboscis is ejected, and the organ is used to perforate the sand. They apply the pointed snout to the surface, and then by a vigorous thrust of the proboscis a considerable space is penetrated. They seem to be liable to wounds and ruptures, and are irritable.

In the cavity (stomach) behind the proboscis in one from the south west of Ireland was a considerable portion of a *Capitella*, so that like many other Annelids the species is carnivorous.

The early description of Delle Chiaje (1825) with the accompanying figures is recognizable, especially by aid of the subsequent observations of Claparède and a specimen kindly sent by E. Grube. Delle Chiaje records the actions of the proboscis on immersing the animal in spirit.

[1] 'Mitth. Zool. Stat. Neap.,' xiii, p. 491.

The *Nereis alba*, Bruguière, in the 'Encyclop. Méthodique' (1827), in so far as the structure of the foot is given, approaches the southern variety of this species.

The *Glycera Rouxii* of Audouin and Milne Edwards (1834) agrees with this form very closely, though some are doubtful on this head.

Leidy's *Glycera americana*[1] would appear to resemble this species in essential points.

The *Glycera gigantea* of De Quatrefages[2] is apparently this or a closely allied form.

In all probability the *Glycera mitis*[3] and *G. dubia* of Dr. Johnston pertain to this species, and the same may be said of *Glycera nigripes*, a variety.

Grube[4] distinguishes *G. Rouxii*, Aud. & Edw., from this species by the fact that both hind lobes are long, yet a little shorter than the anterior. All the lobes are thus somewhat long, pointed or a little rounded. Ventral cirrus somewhat pointed, about as long as the hind lobe. Papillæ of proboscis digit-like, blunt.

Roule (1896) describes a *Glycera convoluta*, Keferstein, from the 'Caudan,' but there is nothing to indicate its special differentiation.

De St. Joseph, while entering *Glycera tesselata*, Grube, from St. Marguerite, also states that he found *Glycera tridactyla*, Schmarda, at St. Raphael, a species which Marenzeller (and apparently he also) identifies with Keferstein's *Glycera convoluta*—here regarded as a synonym of the British form.

Eisig[5] considered that this species exhibited mastigo-helicoidal locomotion, and cryptoid when boring in sand. Those deprived of the head did not survive.

Group II.

With branchiæ.

4. Glycera alba, *De Blainville*, 1828. Plate LXV, fig. 1—proboscis; Plate LXXVI, figs. 3–3 *c*—feet; Plate LXXXV, figs. 5 and 5 *a*—bristles.

Specific Characters.—Head acutely tapered, with eight segments and four short tentacles at the tip. Body of considerable length (6 to 8 ins.), the segments (100, Ehlers) two-ringed, rounded dorsally and somewhat flattened ventrally, each surface with a median line. The proboscis is short and clavate, and its papillæ are small and clavate. It is marked by longitudinal bands, and is transversely wrinkled distally in extrusion. The dorsal cirrus is short with a constriction at the base. The foot is somewhat short anteriorly, longer posteriorly, and in front soon presents two spines and a branchial process, the wall of which differs in structure from the lobes. The branchiæ occur on all the feet, except the first and last (about twelve in each case), and arise from the dorsal edge of the foot near the tip. In front of the foot are two flattened lanceolate lobes, and

[1] 'Fauna Rhode Isl. and N. Jersey,' p. 147, pl. xi, figs. 49 and 50, 1855. See also Verrill for same form (his *Rhynchobolus americanus*).

[2] 'Annel.,' ii, p. 183, 1865.

[3] 'Cat. Worms Brit. Mus.,' p. 185.

[4] 'Jahresber. Schles. Gesellsch.,' 15th December, 1869, p. 56 (1870).

[5] 'Fauna u. Fl. Neap.,' xxviii, p. 263, 1906.

behind are a conical lobe shorter than the anterior, and a blunt lobe inferiorly. The ventral cirrus is bluntly lanceolate and reaches only to the tip of the blunt lobe just mentioned.

The nerve-cords in section are proportionally smaller than in either *Glycera lapidum* or *G. siphonostoma*, but they have the same relations to the ventral muscles and surface. Large neural canals sub-divided by bridles occur superiorly.

Synonyms.

1791. (?) *Nereis alba*, Linn. Syst. Nat. Gmelin, ed. 13, i, pt. 6, p. 3119.
1806. (?) „ „ Turton's Linnæus, iv, p. 89.
1825. „ „ De Blainville. Dict. Sc. Nat., xxxiv, p. 452.
1828. *Glycera alba*, idem. Ibid., lvii, p. 484.
1843. „ „ Rathke. Beitr. Fauna Norweg., in Nova Acta Acad. Nat. Leop.-Car., t. xx, 1, p. 173, Tab. ix, f. 9.
„ „ „ Œrsted. Annul. Danic. Consp., p. 33, f. 24, 103, 105, 110.
1844. (?) „ *albicans*, De Quatrefages. Ann. Sc. nat., 3e sér. 14, p. 358, pl. ix, f. 6.
1844–5. „ *alba*, Œrsted. Kroyer's Nat. Tids. (Dröbak), p. 411.
„ „ „ idem. Regionis Marinis, p. 78.
1851. „ „ Grube. Fam. Annel., pp. 60 and 131.
„ „ „ Sars. Nyt Mag. f. Naturvid., vi, p. 208.
„ „ *setosa*, idem. Ibid., p. 208.
1857. „ *alba*, Danielssen. Reise, p. 61.
1858. „ „ idem. Ibid., p. 117.
1862. „ *convoluta*, Keferstein. Zeitschr. f. wiss. Zool., Bd. xii, p. 106, Taf. ix, f. 28 and 29.
1864. „ „ Grube. Insel Lussin, p. 83.
„ „ „ Kölliker. Kurzer Ber. Schott., p. 9.
1865. „ *alba*, De Quatrefages. Annel., ii, p. 186.
„ „ *Danica*, idem. Ibid., p. 187.
„ „ *alba*, Baird. Johnston's Cat. Worms Brit. Mus., p. 342.
„ „ *setosa* (partim), Johnston. Ibid., p. 342.
„ (?) „ *fallax*, De Quatrefages. Annel., ii, p. 184, pl. ii, f. 2, and pl. ix, f. 18.
„ (?) „ *albicans*, idem. Ibid., ii, p. 186.
1867. „ *alba*, Parfitt. Trans. Devon. Assoc., ii, p. 26 (sep. copy).
„ *Rhynchobolus convolutus*, Malmgren. Annul. Polych., p. 69, tab. xiv, f. 82.
1868. „ „ Claparède. Annél. Nap., p. 186, pl. xvii, f. 3.
„ *Glycera convoluta*, Ehlers. Borstenw., ii, p. 663, Taf. xxiv, f. 29 and 30.
„ „ *alba*, idem. Ibid., ii, p. 660.
1873. „ „ Kupffer. Jahresb. Comm. deutsch. Meere ('Pommerania'), p. 150.
„ „ „ Willemoes-Suhm. Zeitschr. f. wiss. Zool., Bd. xxiii, p. 348, Taf. xviii, f. 1—3.
1874. „ *Goësi*, McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 200.
„ „ *alba*, Malm. Göteb. vet. o. vitt. Handl., xiv, p. 86.
1875. „ „ McIntosh. Marine Fauna St. Andrews, p. 124.
„ „ „ Möbius. Jahresb. Comm. deutsch. Meere, p. 169.
1879. „ „ Hansen. Nyt Mag. f. Naturvid., xxiv, p. 268.
1883. „ „ Levinsen. Vidensk. Meddel. Foren. Kjöbenh., p. 219.
1885. „ „ Carus. Fauna Medit., p. 223.
„ „ *convoluta*, idem. Ibid., p. 224.
1889. „ „ Wirén. Biol. Fören. Förh. Verhandl. in Biol. Vereins Stockh., Bd. ii, p. 32.
1893. „ „ Levinsen. Vidensk. Ud. "Hauchs," p. 332.

1894. *Glycera convoluta*, De St. Joseph. Ann. Sc. nat., 7e sér., t. xvii, p. 27, pl. ii, f. 30—38.
1897. „ *alba*, Arwidsson. Bih. Vet.-Akad. Handl., Bd. xxiii, p. 14, Taf. i, f. 11—13.
1898. „ „ De St. Joseph. Ann. Sc. nat., 8e sér., t. v, p. 344.
„ „ *convoluta*, Gravier. Compt. Rend. Ac. Sc., t. 126, p. 973.
1901. (?) „ *Goësi*, Hornel. Trans. Biol. Soc. Liverp., vol. v, p. 244.
1904. „ *convoluta*, Allen. Journ. M. B. A., N.S., vol. vii, p. 226.
1905. „ *alba*, McIntosh. Ann. Nat. Hist., ser. 7, vol. xv, pp. 42, 50, and 56.
„ „ „ Graeffe. Arbeit. Zool. Stat. Triest, xv, p. 323.
„ „ *convoluta* (=*G. retractilis*, De Quatref.), idem. Ibid., p. 323.
1906. „ „ Bohn. Ann. Sc. nat., 9e sér., t. iii, p. 109.

Habitat.—Coast of Wales and Cornwall (Baird and Laughrin); Polperro; Plymouth. Stomach of flounder and haddock, St. Andrews and West Sands after storm (E. M.), and dredged off E. Rocks. Outer Haaf, Skerries, Shetland, in seventy fathoms, 1868; nine miles off Balta, fifty to sixty fathoms, 1868; eighty fathoms, St. Magnus Bay, Shetland, 1867 (J. G. J.). Bressay Sound, four to eight fathoms. Cumbræ (Kölliker). In 165 fathoms in muddy sand off Ireland, 'Porcupine,' 1870. Thirty to forty fathoms, Dingle Bay, Ireland, 'Porcupine,' 1870. Off Bundoran, Donegal Bay, 'Porcupine,' 1869. Kenmare River, Roy. Irish Acad., 18th August, 1890. Station III, 'Knight Errant,' 3rd and 4th August, 1880, fifty-three fathoms. Dredged in twenty-four fathoms off the Bass Rock, Firth of Forth (Möbius). Southport Sands, near low water-mark in company with *Sulcator arenarius* and other forms.

Forty-five fathoms off Cape Sagres, and off Cape Guardia, 'Porcupine,' 1870. North Sea. Faröe (Willemoes, Suhm). Japan Sea (Moore, etc.). N. America ? (Levinsen).

Head typical, with eight segments, the tapered tip having four short tentacles.

Body of considerable length, viz., 6—8 ins. or more, slightly tapered in front, more distinctly attenuated posteriorly. It is rounded dorsally, somewhat flattened ventrally, and marked on each surface by a median line. The segments are well defined, and consist of two rings, that from which the foot comes off being slightly the broader. Posteriorly the body is flattened, and ends in a pair of slender cirri. In section the main and subsidiary neural canals are distinct, the latter being somewhat larger than usual.

Proboscis.—In extrusion the organ is short and clavate, with numerous longitudinal striæ, besides transverse wrinkles behind the teeth at the tip, a definite fold marking off this region from that bearing the teeth. The papillæ are small and clavate (Plate LXV, fig. 1), the tip generally presenting a pale ovoid area from pressure. They seem to be somewhat smaller on the transversely wrinkled distal region. The teeth occupy elevated bosses symmetrically arranged in the extruded organ, the mouth being in the centre of a four-lobed area, each lobe passing between the teeth.

In section the body-wall shows more massive dorsal longitudinal muscles, which have only a slight incurvation at the lower edge, and thus they are in contrast with those of *G. lapidum*. The ventral longitudinal muscles, however, are similarly developed, and meet over the small nerve-area inferiorly to a greater extent than in either of the other forms mentioned, only a narrow pedicle passing upward at the ganglia. The circular muscles, as in the others, are powerfully developed. A conspicuous transverse muscle

passes from side to side between the edges of the dorsal and ventral longitudinal muscles under the proboscis. This seems to take the place of the oblique muscles in this region.

The first foot has a single group of two spines, three small lobes, the superior being the shorter, and it bears both dorsal and ventral bristles which extend beyond the lobes. The dorsal basal papilla appears on the first foot and it is conspicuous on the second. The ventral lobe is the shortest in this foot, the two upper being about equal in length. The spines diverge distally, each going to its bunch of bristles (dorsal and ventral), so that in the succeeding feet each spine is connected only with its own group of bristles. The foot thus early shows two spinigerous lobes, two long lobes superiorly extending considerably beyond these, a shorter lanceolate lobe inferiorly, and the basal papilla dorsally.

In its passage backward the dorsal lobe or process, which first appears as a papilla in the anterior region, assumes a more or less erect position, until in the typical foot it arches upward and outward. Moreover, its structure differs from that of the other lobes which are hypodermic, for it shows a close series of spiral or crossed fibres, evidently muscular, and which are probably connected with the respiratory functions of the parts.

Beneath the foregoing are two flattened lanceolate lamellæ—between which the dorsal bristles emerge—supported at the base by their spine. These bristles are translucent and faintly yellowish (Plate LXXXV, fig. 5), with a curvature at the tip and a very slight enlargement, after which the bristle tapers to a fine point.

The ventral bristles again emerge between a short blunt posterior lobe and a lanceolate flap in front. The bristles (Plate LXXXVI, fig. 5 *a*) form two groups which slope gently from the spine. The ventral lobe is bluntly lanceolate, and reaches only as far as the tip of the truncate lobe above. The dorsal papilla is short, with a constriction at the base. The ventral spine is considerably longer than the dorsal.

At the tenth foot (Plate LXXVI, fig. 3) the dorsal lobe is long and with an enlargement at the base dorsally. The other anterior lobe is narrower and somewhat longer, whilst the ventral is shorter and somewhat conical. The upper posterior lobe is papilliform and considerably shorter than the two anterior lobes. The lower posterior lobe is also somewhat pointed or papilliform in this region, but afterwards becomes less acute. The basal papilla (the dorsal cirrus of Ehlers) forms a rounded knob above the base of the foot dorsally.

A considerable change occurs at the twentieth foot, for the slight elevation at the base of the dorsal papilla of the foot has now assumed the form of a short branchia (which is first visible about the twenty-fourth or twenty-fifth foot) extending more than half the length of the upper papilla. The other lobes are similar to those in front except that the lower posterior lobe is now shorter and more truncated. The changes noted are still more evident at the thirtieth, the fiftieth, and the seventieth foot, the last (Plate LXXVI, fig. 3 *a*) presenting a typical condition. The dorsal papilla or cirrus is now on the dorsal base of the foot; the branchia extends considerably beyond the tip of the papillæ. The surface of the organ is corrugated, and a series of crossed fibres (Plate LXXVI, fig. 3 *b*) which indicate the contractile condition of the parts is evident. The various lobes are typical and stand out prominently.

Towards the tip of the tail the branchia diminishes to a small process at the base of

the dorsal lobe, and the dorsal process or cirrus moves inward on the foot. All the long lobes of the foot are now more pointed, this condition being especially marked in the ventral lobe. The lower posterior lobe remains short and rounded.

The branchiæ seem to be readily thrown off in the preparations, and probably even in life, as many in certain examples appear to be in process of reproduction. About ten or twelve segments anteriorly and posteriorly are devoid of them.

In life the dorsum of the foot appears to be specially branchial in function, the interior being boldly ciliated, and the rich crimson perivisceral corpuscles rush to and fro and revolve rapidly. In the sickly animal the corpuscles tint the dorsum of the foot as well as the superior process. Long motionless processes resembling cilia occur on the slight convexity within the ventral process.

In a form from the south-west of Ireland (1885—log 29, 40 fms.) the lower posterior papilla or lobe is longer than usual, and considerable variation exists in the length of the processes. Thus all the lobes as well as the ventral cirrus are long and pointed in an example dredged by the 'Porcupine' off Cape Sagres (Plate LXXVI, fig. 3 *c*).

In all probability the *Glycera unicornis* of Savigny [1] is this species. Its locality was unknown. He did not distinguish the branchia from the other processes of the feet.

Keferstein [2] described a new species from St. Vaast-la-Hougue which he termed *Glycera convoluta*. So far as can be determined by a perusal of the literature of the subject and of specimens having this name, it would appear to be only a variety of the widely distributed *Glycera alba*, H. Rathke, and in this Bidenkap [3] and De St. Joseph [4] now agree. Such also was the opinion of Grube, though he indicated certain differences in the feet and in the papillæ of the proboscis.

It is doubtful if the *Rhynchobolus convolutus* of Claparède [5] (*Glycera convoluta*, Kef.) is other than a variety of *G. alba*, though he gives fourteen spurious segments to the prostomium, and he places the branchia further from the tip of the foot than Keferstein.

Willemoes-Suhm (1873) gives a brief account of the sense-organs (nuchal organs) of this species from Faroë. It is a protrusible structure on the dorsum of the segment on each side in front of the first bristles.

Levinsen (1883) would be inclined to place Malmgren's *Glycera Goësi* under this form.

Wirén [6] refers to the composition of the perivisceral fluid of this species and the presence of hæmoglobin.

This may be the species referred to by Miss Newbigging from the Clyde at Millport.[7]

[1] 'Syst. des Annel.,' p. 37.

[2] 'Zeitschr. f. wiss. Zool.,' xii, p. 106, Taf. ix, figs. 28 and 29.

[3] 'Christ. Vidensk. Selsk. Förhandl.,' 1894, p. 77.

[4] 'Ann. Sc. nat.,' 8e sér., t. v, p. 345.

[5] 'Annél. Nap.,' p. 186, pl. xvi, fig. 3, 1868.

[6] "Oni blodet och blodomloppet hos *Glycera alba*, H.R.," 'Biol. Fören. Förhandl.,' Stockholm, Bd. ii, p. 31, 1889.

[7] 'Communic. Millport Mar. Lab.,' i, 1900, p. 4.

5. Glycera goësi, *Malmgren*, 1867. Plate LXV, fig. 2—head; Plate LXXVI, figs. 4–4 *b*—feet; Plate LXXXV, figs. 6 and 6 *a*—bristles.

Specific Characters.[1]—Head a short cone of eight or nine segments with the usual terminal tentacles. Body about 5 or 6 ins. in length or more, and segments two-ringed. The surface is firm and somewhat tessellated at the sides, and the anterior end appears to be less tapered. Branchiæ begin on the thirty-second foot and continue nearly to the posterior end (incomplete). Proboscis massive, clavate, brownish. The lateral spur of each tooth is of moderate length and has a triangular anterior crest or process. Papillæ conical with interspersed globular ones. Typical foot of considerable depth, with the dorsal cirrus at the base of the foot. Branchia simple, on the anterior surface of the foot and directed forward and slightly upward. It appears about the thirty-second foot and continues to the posterior region of the body. Two long lobes occur anteriorly at the tip of the foot, and two shorter flattened lobes—the lower by-and-by being the shorter—occur posteriorly, and a short ventral cirrus with an oblique and rather blunt tip.

Synonyms.

1845. (?) *Glycera Rouxii*, Œrsted. (Dröbak.) Nat. Tids., n.r., Bd. i, p. 411, f. 1.
1865. (?) ,, *branchialis*, De Quatrefages. Annel., ii, p. 182.
1867. *Glycera Goësi*, Malmgren. Annul. Polych., p. 71, Tab. xiv, f. 81.
1874. ,, ,, Malm. Göteb. vet. o. vitt. Handl., xiv, p. 86.
1875. ,, *Goesi*, Ehlers. Zeitschr. f. wiss. Zool., Bd. xxv, p. 56.
1897. ,, *Rouxii*, Michaelsen. Polych. Deutsch. Meere, in Komm. deutsch. Meere., n.f., Bd. ii, p. 27, Taf. i, f. 9 and 10.
,. ,, *Goësi*, Arwidsson. Bih. t. K. Sv. Vet.-Akad., Bd. xxiii, pp. 4 and 19, Taf. 1, f. 14—16; Taf. 2, f. 1—5.
1898. ,, *Mesnili*, De St. Joseph. Ann. Sc. nat., 8e ser., t. v, p. 339.
1903. ,, *Gœsi*, Moore. Proc. Acad. Nat. Sc. Philad., vol. v, p. 464.
1905. ,, *Goësi*, McIntosh. Ann. Nat. Hist., ser. 7, vol. xv, p. 43.

Habitat.—110 fathoms, thirty miles west of the Blasquet, S.W. Ireland. Bay of Galway, fifteen to twenty fathoms. Dredged in 160 fathoms fifty-five miles west of Valentia (J. G. Jeffreys, 1870). In the Minch, at eighty fathoms, as well as at Station XLV in 426 fathoms in the 'Porcupine' Expedition of 1869. Plymouth (Allen, as *G. Mesnili*).

Extends to Sweden. Japan (J. P. Moore). In forty-five fathoms off Cape Sagres, 'Porcupine,' 1870.

Head (Plate LXV, fig. 2) a short cone of eight or nine segments with the terminal tentacles as usual.

Body of considerable size, probably 5 or 6 ins. in length, though incomplete posteriorly, and the segments are two-ringed. The surface is firm and somewhat

[1] Grube characterizes this form (*G. unicornis*) as having the hind lobes of the foot shorter than the anterior. Papillæ of the proboscis small, leaf-like; others knob-like.

tesselated at the sides, and the anterior end appears to be less tapered than in the ordinary forms, being rounded at each side of the base of the snout. In life the body is pale reddish.

Proboscis (Plate LXV, fig. 2 *a*) massive and clavate, of a pale brown colour in the preparations, with the four teeth in the normal position. The lateral spur of the tooth is of moderate length, and has a somewhat triangular anterior crest or process, that is, it projects toward the central region of the organ in extrusion (under cover of the muscles). The papillæ are conical, and amongst them are a few more or less globular.

In section of the body-wall the nerve-area is wider transversely, and thus has a more extensive muscular covering than in its allies. The gut has a thin muscular coat, and the dorsal vessel projects freely above it, only the lower border being fixed closely to the intestine. The peritoneal layer surrounds both.

The foot is of moderate length and considerable depth, having anteriorly two elongated papillæ and posteriorly two slightly shorter and also pointed papillæ. Dorsally is a single branchial stem, whilst ventrally is the cirrus, which is somewhat lanceolate. The dorsal cirrus occurs at the base of the foot.

The typical foot (Plate LXXVI, fig. 4) of this species differs from that of *Glycera alba*, H. Rathke, to which it is somewhat allied by the position and size of the branchia, and by the fact that both posterior lobes are somewhat elongated and conical.

The tenth foot (Plate LXXVI, fig. 4 *c*) has a comparatively large and slightly clavate dorsal cirrus, two long anterior lobes, the upper occasionally being flattened and bifid at the tip, two flattened conical posterior lobes about equal in length and considerably shorter than the anterior, and a short ventral cirrus with an oblique and rather blunt tip.

The chief difference at the twentieth foot is the slight increase of the ventral cirrus, the tip of which is more pointed.

About the thirty-second foot a papilla appears on the anterior surface, and midway between the base and the tip—the first evidence of the branchia; and in the subsequent feet this develops into a conical process, of comparatively small size, which is directed forward and slightly upward (Plate LXXVI, fig. 4′ representing the thirty-eighth foot), and it continues to the end of the body, which, however, is not quite complete. This and the long dorsal cirrus give a character to the foot. As an exceptional condition one branchia, the sixth after the commencement on the right side, was large (almost as long as the foot), and consequently it impinged against the foot in front, and curved upward. The position of the branchiæ makes it difficult to see them when the feet are placed vertically on a slide.

Both dorsal (Plate LXXXV, fig. 6—dorsal) and ventral bristles (Plate LXXXV, fig. 6 *a*—ventral) are comparatively slender and long, but there is little in their minute structure to differentiate them from allied forms.

The foot alters little in its progress backward (Plate LXXV, fig. 4 *b*), and the prominent and pointed posterior lobes are easily observed under a lens, for they are usually directed backward whilst the anterior point forward. Occasionally, however, the lower lobe is blunt, thus simulating the condition in *Glycera alba*, H. Rathke, but the normal arrangement is as mentioned. In one also, whilst the lobes were of equal length, the lower was the broader.

Œrsted's *Glycera Rouxii* (1844—5) is a species requiring further investigation, for his figure of the foot more resembles that of *G. siphonostoma* than that of *G. Goësi*.

The *Glycera fallax* of De Quatrefages[1] is probably this species or *G. alba*, in which the branchiæ (ovaria, Kinberg) have assumed a globular form either from softening or otherwise. The same explanation suffices for Mr. Parfitt's *Glycera vesiculosa*, n. s., in which the author places the branchiæ on the anterior aspect of the foot, as in the present species.

The *Glycera branchialis* of De Quatrefages[2] seems to be an allied form, the branchiæ springing from the anterior and upper part of the foot. His *G. albicans*[3] is a similar form, but he describes the branchiæ as arising from the upper and posterior part of the foot.

Ehlers (1868) states that the branchiæ in *G. unicornis* spring from the anterior border of the foot—just as occurs in that from St. Magnus Bay, only two processes characterize the branchiæ of that species. Moreover, he describes the branchiæ as present on all the feet between the twenty-third and last four, and mentions that some are bifid. He observes that two kinds of papillæ occur on the proboscis.

Such, therefore, would agree with the *Glycera Meckelii*, Aud. & Edw.,[4] in regard to the branchiæ.

The *Glycera decipiens* of Marenzeller,[5] from the Bay of Müja in Japan, appears to resemble this species very closely, both in regard to the position of the branchiæ and the structure of the feet.

There is much in the structure of *Glycera sagittariæ* procured off the Tetuaroa Islands by the 'Challenger'[6] that agrees with this species, which may yet be found to have a very wide distribution. It is true the branchiæ commence only after the thirtieth foot, but variation may occur in this respect.

Marenzeller (1902) gives a careful criticism of the synonymy of this form, which he considers to be the *Glycera Rouxii* of Audouin and Edwards. He shows that the lower posterior lip is shorter than the upper, and that the branchiæ (which are simple) are retractile and on the anterior border of the foot, and that while the latter is also the condition in *G. unicornis*, Savigny, the branchiæ in that form are forked.

Arwidsson (1897) describes the branchiæ as occurring on segments 29 to 190, and gives a sketch of the teeth of this form and of *Glycera alba*, the teeth of the latter having a much broader base.

This is not the *Rhynchobolus siphonostoma* of Delle Chiaje (1842) from Naples, a species having a great development of the branchiæ, which are bifid and conspicuous, but it may be Malmgren's *G. Rouxii*, Œrsted.

[1] 'Ann. Sc. nat.,' 3e sér., t. xiv, p. 358; and 'Annel.,' ii, p. 184, pl. ii, fig. 2.
[2] Op. cit., ii, p. 182.
[3] Op. cit., ii, p. 186; and 'Ann. Sc. nat.,' 3e sér., t. xiv, p. 358, 1850.
[4] 'Règne Anim., Annel.,' pl. xiv, fig. 2.
[5] 'Sudjap. Annel.,' op. cit., p. 140, Taf. vi, fig. 3, 1879.
[6] 'Annelids,' p. 346, pl. xlii, fig. 8, pl. xxii A, fig. 10, 1885.

Family XIV.—Ariciidæ, *Audouin and Edwards*, 1834.

Head (prostomium) a pointed cone, with or without eyes, and devoid of processes. Peristomial segment without appendages. Body tapered anteriorly and posteriorly, flattened dorsally, rounded ventrally. Segments narrow. Proboscis a frilled rosette. Tail with two long cirri. Feet dorsal in position, the ventral division being dorso-lateral anteriorly and dorsal posteriorly. Branchiæ ligulate, dorsal. Rows of papillæ behind the anterior feet.

Bristles of several kinds—elongated and tapering bristles peculiarly serrated so as to appear camerated, simple tapering bristles, or the bases of the stronger ventral serrated forms modified by friction.

The nerve-cords (Fig. 93) anteriorly pass from the ganglia to the ventral surface, where they are at first widely separated, a broad band of transverse fibres intervening.

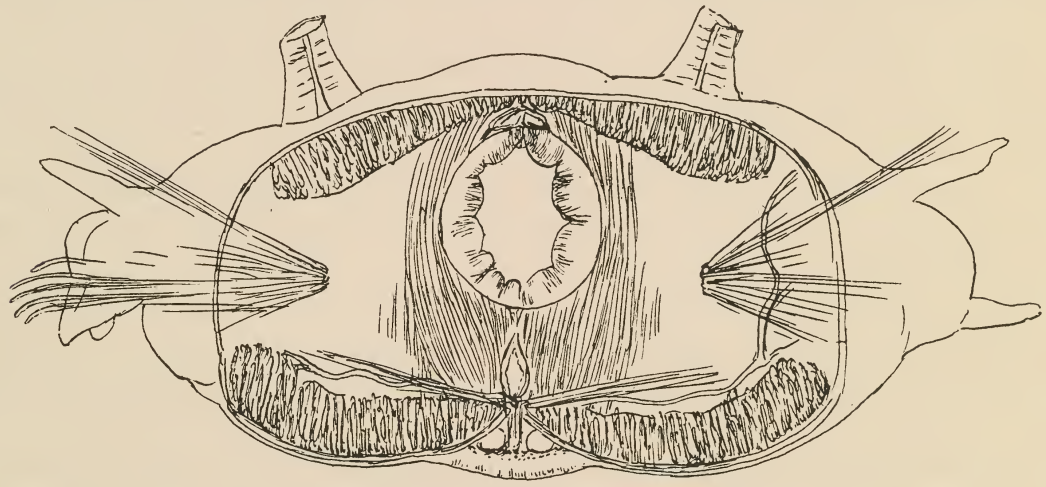


Fig. 93.—Transverse section about the anterior third of *Aricia Latreillii*, Aud. & Edw.

They lie outside the circular layer, and beneath and external to the oblique bands at the inner edge of the ventral longitudinal muscles. Then the median space contracts, the nerves approach each other at the inner edge of a somewhat triangular area of hypoderm, the circular coat bending upward along the inner edge of the ventral longitudinal muscles to the raphe on each side at the summit, to which the oblique muscles are attached. The hypodermic area in this region is larger than it is posteriorly, and the surface is raised, not grooved. By-and-by, however, a broad groove appears and then the narrow one posteriorly. Toward the middle of the body the trunks have been pushed further inward and are closely enveloped laterally by the ventral muscles, the fibres being bound by a thin band of the circular muscle, which is intimately applied to the sheath of the area. The latter is now somewhat clavate in outline (Fig. 94), springing by a slightly wider base from the line of the ventral median groove, and marked by transverse fibres at the base (externally); indeed, this narrower region below the cords is transversely streaked throughout and has minute (stained) nuclei here and there. The cords occur at the upper or inner dilatation, and are ovoid in outline, with a large neural canal in the centre superiorly. Occasionally two smaller lateral canals are visible on the same level. Groups

of deeply stained nuclei occur below the cords. The oblique muscles are attached to the upper arch, to the middle of which the gut is fixed by strong converging muscular fibres, so different from the usual lax band attached first to the ventral vessel and then to the arch of the cords.

Audouin and Milne Edwards regarded the genus *Aricia*, Savigny, as intermediate between the Errant Annelids and the Tubicola, and also possessing certain modifications of structure found in the Terricola.

Their bodies are long, flattened dorsally and rounded ventrally, with numerous segments. Head small, conical, of one segment, devoid of appendages. The proboscis is unarmed. From the second segment backward are feet, the first twenty or thirty having two divisions which differ from each other, whilst the subsequent feet have divisions resembling each other and dorsal in position.

Œrsted[1] (1844), grouping the Annelids under three great divisions (his orders), viz., Maricolæ, Tubicolæ, and Terricolæ, further subdivided the Maricolæ into the Chætopoda,

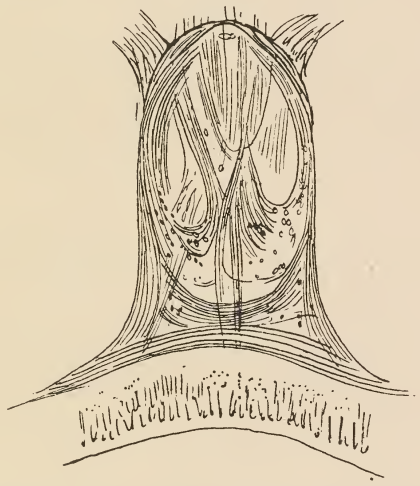


Fig. 94.—Highly magnified view of the nerve-area in *Aricia Latreillii* towards the middle of the body. The hypoderm and cuticle are below.

which he split into the *C. trematodina*, *C. vera*, and *C. terricolina*, the family Ariciæ constituting the second of the last section. He characterized them as having a somewhat rounded body of a definite number of segments, a simple alimentary canal without maxillæ, and a head with rudimentary appendages. But his family contained diverse forms now included under several families, and those dealt with here fell under his Ariciæ veræ, in which the pinnæ and branchiæ are dorsal, and the tentacular appendages absent or rudimentary.

Grube[2] chiefly followed the arrangement of Œrsted in his tenth family Ariciea, Aud. & Edw., grouping the Spionidæ, Sphærodoridæ, and Cirratulidæ as well as the Ariciidæ under this heading, but he separated the *Opheliidæ*.

Dr. Thomas Williams[3] observes that the segmental organ is very prominent in this group, though limited to the two posterior thirds of the body. The ova and sperm-

[1] 'Arch. f. Naturges.,' Bd. x, p. 102.
[2] 'Fam. der Annel.,' p. 64, 1851.
[3] 'Philos. Trans.,' 1858, p. 125, pl. vii, fig. 17.

bearing masses exhibit the same relation to the tube as in *Nereis*, and they occupy the floor of each segment. The areolated tissue in which the ova are contained is distinguishable, he states, into two parts, one of which is densely and intimately connected with the blood-vessels, the other forming a mere utricular receptacle for the generative elements.

The second division of Levinsen's[1] Syllidiformia contains six families, viz., Spionidæ, Chætopteridæ, Cirratulidæ, Ariciidæ, Chloræniidæ (?), and Ophelidæ (?) They are termed the *Syllidiformia spionina*. This arrangement might be improved, as also might Benham's view that the family lies between the Sphærodoridæ and Typhloscolecidæ of his sub-order Nereidiformia.

Kinberg describes the Ariciea as devoid of jaws, pharyngeal papillæ near the margin of the mouth small or obsolete, tentacles, antennæ, and palpi absent or minute, no eyes, cephalic lobe conical, terminal; buccal segment devoid of feet; tentacular cirri two or none; a change in the structure of the segments; branchiæ cirrose, dorsal, absent from the anterior segments; setæ numerous, capillary and annulate. He considered the dorsal cirrus a second branchia, whilst a third was at the extremity of the dorsal division of the foot, and a fourth a papilla near the ventral division. He arranged the genera according to the presence of cephalic appendages—*Aricia* having four; by the tentacular cirri, the position of the branchiæ, and the condition of the bristles. His uncertainty on the subject is further shown by his separating Anthostoma of Schmarda as a distinct family.[2]

De Quatrefages (1865), like others, separated the Ariciidæ from Audouin and Milne Edwards' group, containing *Aonia*, *Ophelia*, and *Cirratulus*, as a separate family, and arranged them in two great divisions according to the nature of the proboscis, sub-dividing the first series by the structure of the feet, the bristles, tentacles, and caruncle.

Cunningham[3] says: "In the Ariciidæ I need only confirm the account given by McIntosh, that in the middle of the body the nerve-cords are thrust inwards by the great ventral longitudinal muscles, which contain between them a narrow lamina preserving the connection between the nerve-cords and the epidermis. A single median neural canal runs above the nerve-cords as in *Nerine*."

In regard to organs of sense, pairs of otoliths were described by Bobretzky[4] in *Aricia capsulifera* of the Black Sea in certain segments behind the third, and in *Aricia Œrstedi*, Claparède,[5] by Marion and Bobretzky[6] at Marseilles, a form with six pairs of otocysts. Langerhans[7] further mentions in *A. acustica* similar organs situated dorsally in segments eight to eleven, and, as Fauvel points out, dorsal to the feet, whereas the ciliated organs are ventral to the dorsal division. The latter author[8] has recently found in *Scoloplos armiger* an otocyst containing grains of quartz in connection with the external ciliated

1 'Vidensk. Meddel. Kjöbenhavn,' p. 180, etc., 1883.
2 'Öfvers. af K. Vet.-Akad. Förh.,' No. 9, 1866, p. 337.
3 'Quart. Journ. Micros. Sc.,' vol. 28, p. 273, 1888.
4 'Black Sea Annel.' (Not seen.)
5 'Glanures Zoot.,' p. 42.
6 'Ann. Sc. nat.,' 6e ser., t. ii, p. 68.
7 'Zeitschr. f. wiss. Zool.,' Bd. xxxiv, p. 88, Taf. iv, figs. 1—9.
8 'Ann. Sc. nat.,' 9e sér., t. vi, pp. 17—25, text-figs. iv and v, pl. iii, figs. 19 and 20, 1907.

organ in a small number of the anterior segments only (4—5 to 13—15), whilst the lateral ciliated organs occur in every segment. The otocyst is situated at the base of the dorsal cirrus and opposite the ciliated organ in the form of a diverticulum of considerable depth. Its walls have thick cuticle without cilia, and the surrounding cells are finely granular and stain deeply, and their extremities are fibrillar. Thus two sense-organs occur in the Ariciidæ, viz., the ciliated organs and the otocysts.

Häcker (1896) includes the Ariciidæ amongst those with non-pelagic larvæ, and he alludes to a six days' old larva of *Aricia fœtida*, described by Salensky,[1] with three ciliated rings in addition to the cilia of the prototroch.

Kostanecki[2] subjected the eggs of *Aricia* to an acid solution (acetic and nitric), and then to a hypertone solution, with the result that certain ova segmented into three or four blastomeres, and a few reached the six- to eight-celled stage.

An interesting memoir lately published by Ceruti[3] places the genera *Aricidea* and *Paraonis* on a proper footing, and demonstrates that they pertain rather to the group of the Spionidæ than to the Ariciidæ. This group will subsequently be dealt with.

The distribution of the Ariciidæ is still in need of elucidation, but certain European forms would appear to stretch to the eastern American shores, where, under new names, it is not always easy to identify them. Some are littoral, whilst others frequent water of considerable depth.

Genus LXXVII.—Aricia, *Savigny*, 1820.

Head pointed, without tentacles; mouth with a foliaceous proboscis. Body more or less elongated, flattened dorsally and rounded (convex) ventrally, little tapered anteriorly, but slender posteriorly, and ending in two slender caudal cirri. Regions of the body two, the anterior with rudimentary feet and peculiar spines, the posterior with dorsal and ventral divisions better developed. Branchiæ commence about the fifth foot, and continue throughout. Bristles club-shaped serrated forms and peculiar serrated (camerated) forms with tapering tips. Body-wall as in the family.

1. Aricia Cuvieri, *Audouin and Edwards*, 1833. Plate LXXVI, figs. 5–5 *c*—feet; Plate LXXXV, figs. 7–7 *b*—bristles; Plate LXXXVII, fig. 18—body.

Specific Characters.—Head a short pointed cone without trace of rings or eyes. A transverse line separates it from the peristomial segment ventrally, but dorsally a crescent is cut from the latter at the base. Body slightly diminished in front, gradually tapering posteriorly and reaching eight or more inches in length. It is flattened dorsally and rounded on the ventral surface anteriorly. Segments narrow. In transverse section dorsally it is concave anteriorly and flattened posteriorly; convex ventrally. Peristomial segment narrow dorsally, but broad ventrally. Proboscis forms in extrusion a frilled

[1] 'Étud. Devel. Annél.,' i, taf. vii, fig. 8, *a*, *v*.

[2] 'Journ. R. Micros. Soc.,' 1909, p. 575 (from 'Bull. Internat. Acad. Sc. Cracovie,' 1909, pp. 238—253, 16 figs.).

[3] 'Mitth. Zool. Stat. Neapel.,' Bd. xix, pp. 459—512, Taf. xviii and xix, 1909.

rosette. Feet dorsal in position, the ventral cirrus being dorso-lateral. Posteriorly body tapers to a blunt point with the anus at the tip dorsally, and with two very long and very slender cirri arising at the anterior part of it.

The first region of the body comprises twenty-one feet, but these vary considerably amongst themselves, commencing with a rudimentary foot anteriorly and ending in modified feet toward the twenty-first. From the sixth foot backward the posterior of the three rows of ventral bristles is darker, and is composed of spines increasing in strength, so that they form a conspicuous row of brown dots. The foot becomes more free and the posterior row of papillæ more conspicuous, extending ventrally beyond the bristles at the seventeenth foot. From the nineteenth to the twenty-fourth these papillæ go to the mid-ventral line. The rows of ventral bristles attain their maximum about the fifteenth or sixteenth foot. The dorsal cirrus increases in size in its progress backward and has an enlargement at the base. The branchiæ commence at the fifth foot, and are of a rich red colour in life. In the succeeding region of the body (at and after the twenty-second foot) the dorsal division has in front a long tuft of serrated and slightly camerated bristles, and behind is a large dorsal cirrus with blood-vessels. Below, after an interval, is a smaller cirrus, also with a distinct vessel. The ventral division consists of a setigerous process with a long papilla (ventral cirrus ?) and a few very slender bristles of the same type as the dorsal. The camerated or peculiarly serrated bristles disappear posteriorly, long simple tapering bristles taking their places in both divisions of the foot.

Synonyms.

1833.	*Aricia Cuvieri*,	Audouin and Edwards.	Ann. Sc. nat., t. xxix, pl. xv, f. 5—13.
1834.	,,	,,	idem. Annél. (Faun. Lit. Fr. ii), p. 258, pl. vii, f. 5—13.
1837.	,,	,,	M. Edwards. Règne Anim. Illust., pl. xvii, f. 1.
1840.	,,	,,	Grube. Actin. Echinod., etc., p. 69.
1851.	,,	,,	idem. Fam. Annel., pp. 68 and 135.
1865.	,,	,,	De Quatrefages. Annel., ii, p. 283.
1867.	,,	,,	Malmgren. Annul. Polych., p. 71.
1869.	,,	,,	McIntosh. Rep. Brit. Assoc. (1868), p. 339.
1873.	,,	,,	Sars. Bidrag Christ. Fauna, iii, p. 31, Tab. xviii, f. 17—23.
,,	,,	,,	Willemoes-Suhm. Zeitschr. f. wiss. Zool., Bd. xxiii, p. 348.
1874.	,,	,,	McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 200.
,,	,,	,,	Malm. Göteb. vet. o. vitt. Handl., xiv, p. 91.
1875.	,,	,,	McIntosh. Invert. and Fishes St. Andrews, p. 124.
1879.	,,	,,	Tauber. Annul. Danic., p. 106.
1893.	,,	,,	Levinsen. Vidensk. Ud. "Hauchs," p. 336.
1904.	,,	,,	Allen. Journ. M. B. A., N.S., vii, p. 227.
1905.	,,	,,	McIntosh. Ann. Nat. Hist., ser. 7, vol. xv, pp. 44 and 50.
1906.	,,	,,	De St. Joseph. Ann. Sc. nat., 9e sér., t. iii, p. 167.

Habitat.—Dredged in twelve fathoms west of Peel, Isle of Man; 'Porcupine' Expedition of 1869 in 164 fathoms, on a bottom of greyish sand, stones and coral; and in same Expedition at a depth of 422 fathoms; 'Porcupine' Expedition, 1870, Station VI, Lat. 48° 26′ N., Long. 9° 44′ W., in 358 fathoms on sand, bottom temperature 50°. At Station VIII, in 257 fathoms; Royal Irish Academy's Expedition to S.W. Ireland, No. 122.

Bergen, Norway (Sars, Norman); Greenland; 'Porcupine,' 1870, Station XXV, in 374 fathoms, and bottom temperature 53·5°.

Head a short pointed and very mobile cone without trace of rings or eyes. A transverse line separates it ventrally from the peristomial segment, but dorsally a crescent is cut from the latter at the base. It is dull salmon-yellow in colour like the rest of the body, with an opaque brownish patch in the centre.

Body (Plate LXXXVII, fig. 18) of considerable length, slightly diminished in front and gradually tapering posteriorly. It is somewhat flattened on the dorsal surface and rounded on the ventral surface anteriorly. The anterior region has twenty-one segments.

Posteriorly the body diminishes to a blunt point, with the anus at the tip dorsally, with two lateral flaps, a ventral process and papilla, and with two very long and very slender cirri passing off from the anterior part of it as in *A. Latreillii* (Plate LVI, fig. 1*a*). The dorsal processes (branchiæ and feet) towards the tip of the tail gradually leave the middle bare and pass to the sides in a diminished condition, even ceasing as distinct lateral papillæ before reaching the line of the vent.

The peristomial segment is narrow dorsally, but broad ventrally, the mouth forming a puckered orifice in the centre of the ventral surface towards its posterior border. Two crescentic lips occur laterally, while the posterior margin of the mouth has a series of symmetrical longitudinal furrows passing forward from the segments behind.

The *proboscis* forms a deeply frilled organ, which projects from the mouth as a button-like process. There are about ten frills in the form of a rosette.

The first bristled segment of the body has dorsally a low papilla, from which a tuft of tapering and finely camerated pale-yellow bristles emerges, and a minute cirrus is present. The bristles spread over the dorsum in a fan-like manner, almost approaching the middle line. The ventral division is formed dorsally of similar bristles at its upper and lower edges and here and there along the row, but the main part of the row consists of the broken basal regions of the bristles, which often retain the camerated marks on one side and which have a distinct curve toward the tip, the convexity being on the smooth edge. The tips of these fragmentary bristles, especially inferiorly, have been worn apparently from use, so that they are smoothly rounded. The second foot has a longer dorsal cirrus and a similar tuft of bristles in the division. The ventral row of bristles is longer, and it has posteriorly a flap with several (four) papillæ. The bristles have the same character as in the first foot, and the area forms a file-like surface from the broken ends of the bristles. The third foot is similar, though longer from above downward, and it has a posterior fringe of six papillæ. The same may be said of the fourth foot, only the dorsal cirrus is longer. At the fifth foot a branchia appears on each side dorsally and it approaches the middle line more nearly than to the dorsal cirrus. The fimbriæ or papillæ behind the foot are also more numerous, and the four rows of bristles show signs of wear.

The feet have the same structure (Plate LXXVI, fig. 5, which represents the tenth), to the nineteenth, though the following changes are noted. From the sixth foot backward the posterior of the three rows of ventral bristles is darker and composed of spines increasing in strength so that they form a conspicuous row of brown dots. The foot also becomes more free and the posterior row of papillæ more conspicuous, whilst they extend ventrally beyond the bristles at the seventeenth or eighteenth foot, though in others with

thirty-one segments anteriorly it is the twentieth, about five free papillæ, that is, beyond the foot, occurring at the eighteenth foot. At the nineteenth, twentieth, twenty-first, twenty-second, twenty-third, and twenty-fourth the papillæ extend to the mid-ventral line along the anterior edge of the segment. The ventral rows of bristles attain their maximum development about the fifteenth or sixteenth foot, where there are twenty-one, and diminish subsequently, the last occurring on the twenty-first foot as a small patch considerably less than the first. The dorsal cirrus increases in size in its backward progress, and shows an enlargement at the base.

The dorsal bristles (Plate LXXXV, figs. 7, 7′, 7″) are finely tapered and marked by minute transverse rows of spikes, which give a camerated aspect to the structure. They curve inward towards the branchiæ anteriorly, but after the alteration of the feet they project over them. The strong, brown, curved spines of the ventral rows (Plate LXXXV, figs. 7 *a* and 7 *b*) do not, in those best developed, show any trace of the camerated condition, but so many intermediate forms occur that it is not improbable that originally the majority sprang from such at first. In glancing along the ventral divisions of the feet, the strong brown spines of the posterior row become distinct about the sixth foot, and increase in size in the following feet. The rows of papillæ behind the spines and bristles of the anterior feet evidently perform important functions in the operations of the region. They all slope backward.

The twenty-second foot (Plate LXXVI, fig. 5 *a*) inaugurates a change in the structure, for, whilst the branchiæ continue as before in the mid-dorsal line, the ventral division has no rows of strong bristles. The dorsal division has in front a long tuft of camerated bristles tapering to fine points, and behind the large dorsal cirrus. Below, after an interval, is another smaller cirrus, then a setigerous process with a long papilla, and a few very slender bristles of the same type as the others (camerated). Lastly, the papillæ form a row to the mid-ventral line. The function of these ventral papillæ may be connected either with tube or tunnel in sand. This type of foot (Plate LXXVI, fig. 5 *b*) is continued to the thirtieth, and then the camerated bristles disappear, simple long tapering bristles taking their places in both divisions of the foot.

The posterior feet show to the exterior of the large flattened branchial process a long tuft of bristles with a knife-shaped cirrus behind it, the cirrus having a narrow pedicle with a broad blade tapering to a point beyond it (Plate LXXVI, fig. 5 *c*); then comes a cirrus, followed by the ventral division in the form of a bifid process with a long tuft of tapering bristles, and a short conical ventral cirrus externally. The foot is dorsal in position, even the ventral cirrus being dorso-lateral.

The branchiæ, as Claparède so clearly showed,[1] have two vessels, with a numerous series of transverse or connecting trunks.

Only twenty ventral rows occur in an example from S.W. Ireland (122), but the papillæ are larger. Another small example, dredged at 422 fathoms during the 'Porcupine' Expedition of 1869, had only nineteen of the bristled rows of the ventral division. Moreover, whilst the strong upper brown spines showed no trace of transverse markings (cameræ) the inferior did so. The great thickness of the upper spines made it probable that either a new growth had taken place in the bristle sac, or that an increment had

[1] 'Recherches sur la Struct. Annél. Sédent.,' pp. 106, 109, and 192–3, pl. xiv, figs. 3 and 4, etc.

ensued on the base of the old bristle. Another small example had only eighteen of these ventral rows of bristles. Thus the number of the ventral rows seems to increase with age.

In a small specimen from 164 fathoms in the 'Porcupine' Expedition of 1869 all the bristles were pale yellow, and a few of the stout curved stumps occurred in the twenty-second foot (Plate LXXVI, fig. 5 *a*) amongst the slender bristles, so that they may occasionally be overlooked.

Posteriorly towards the tail the blood in the various dorsal and dorso-lateral processes, which in this region are proportionally long, gives a deep red colour to the parts.

Most specimens consist of the anterior region only, so that they probably frequent the sand or gravel.

Reproduction.—Lo Bianco[1] found *A. fœtida*, Clap., ripe from January to June at Naples. The eggs are of a greenish colour, and deposited in a cylindrical vermiform mass of mucus.

This was the type of Audouin and Edwards (1834) which Cuvier had procured on the French shores, and their description and figures are for the most part good.

De St. Joseph (1906) distinguishes between this species and *A. Latreillii*, Aud. and Edw., by the shorter anterior region in the latter, the smaller number of papillose segments, and by the diminution in the number of papillæ in each segment.

2. Aricia Edwardsi, an. var. Plate LXXXVII, fig. 8—foot.

An injured specimen dredged in Busta Voe in forty fathoms by Dr. Gwyn Jeffreys in 1868 offers certain distinctions which would appear to be specific. Thus, whilst in the outline of the head and in the general aspect of the body, and in the commencement of the branchiæ on the fifth bristled segment, it agrees with *A. Cuvieri*, it differs in the darker brown spinigerous rows anteriorly, in the length and slenderness of the papillæ behind the feet, in the conspicuous size and shape of the spine-like bristles of the ventral row, and in the paucity and minuteness of the papillæ which extend ventrally on the segments. As in the majority of these forms, only the anterior and a portion (about three quarters of an inch) of the succeeding region had been secured by the dredge. The head is a short acute cone, and the frilled proboscis projects ventrally from the peristomial segment. The anterior region consists of twenty-one segments, the ventral rows being dark brown, and the last four or five very small. At the tenth foot (Plate LXXXVII, fig. 8) the subulate dorsal cirrus is rather more elongate than in either *A. Cuvieri* or *A. Latreillii*, and the bristles consist of a longer inner (*i.e.*, next the median line) and a shorter outer series of tapering spinous forms. After a considerable interval a long papilla somewhat enlarged at the base occurs to the exterior. It is accompanied by a very powerful and nearly straight spine with a sharp tip, followed by the dark-brown series, some of which are curved at the tip as in the previous forms but far stronger, and moreover they show that the tips are not serrated. The smallest forms are at the extreme

[1] 'Mitth. Zool. Stat. Neap.,' xiii, p. 484.

ventral edge, but all along the row much stouter spine-like bristles occur, and they are either nearly straight or slightly bent at the tip. Short tapering serrated bristles are present throughout. In the ventral division of the succeeding feet all the curved spine-like bristles are stronger than in *A. Cuvieri* and the papillæ have the same character as above. At the twenty-first foot the ventral division has a small group considerably more elongated than in front, but with the terminal curvature, yet no trace of serrations occurs. Even in this, the last of the series, the bristle-like spines are remarkably strong. They are accompanied by the short, tapering, serrated (camerated) bristles. The papillæ remain elongated. The condition of the preparation does not admit of minute description, since the parts are much altered, but the change occurs at the twenty-first foot, which has an elongated ventral cirrus and a tuft of the usual bristles serrated at the tip. At the thirty-first the branchia is fairly large, the dorsal cirrus slightly enlarged in the middle, and a tuft of somewhat stiff bristles serrated at the tip. Between it and the ventral division is a cirrus, whilst the ventral setigerous lobe is bifid and bears a few slender elongated bristles spinous at the tip. The ventral cirrus is subulate.

The ventral surface is comparatively smooth anteriorly, for none of the rows of papillæ meet in the middle line, those most nearly approaching it being the eighteenth, nineteenth, twentieth, and twenty-first, though some occur laterally from the seventeenth to the thirtieth foot.

3. Aricia Latreillii, *Audouin and Edwards*, 1834. Plate LVI, figs. 1, 1 *a*.

Specific Characters.—Head as in *A. Cuvieri*. Body 6—8 ins. long, pinkish anteriorly, yellowish-white posteriorly, distinguished by having about thirty-one segments in the anterior division; rows of papillæ on the ventral surface from the twenty-fourth backward more numerous than in *A. Cuvieri*.

Synonyms.

1834. *Aricia Latreillii*, Audouin and Edwards. Annél., p. 259.
1882. „ „ McIntosh. Trans. Linn. Soc., Zool., i, p. 504.

Habitat.—Sandy shores of the Bay of St. Andrews at and beyond low water-mark, and in Laminarian roots tossed on the West Sands after storms. Firth of Forth (J. T. Cunningham).

Head acutely pointed, forming a cone as characteristic as in *A. Cuvieri*.

Body 6—8 ins. long, very little tapered in front, and more distinctly so posteriorly, where it terminates in two long slender cirri. In general appearance it resembles *A. Cuvieri*, but the anterior region is composed of thirty or thirty-one segments with the brownish ventral bristles, is somewhat more firm, and the rings bearing papillæ on the ventral surface from the twenty-fourth backward are more numerous. The body is somewhat flattened dorsally or even hollowed in front, and rounded ventrally, and the segments are very numerous—300 to 400. The proboscis is sometimes ejected as a frilled lobate organ. In life it is of a yellowish-white colour, slightly pinkish anteriorly.

The body-wall anteriorly is characterized by the great development of the circular

muscular bands and the powerful muscles of the feet, but the dorsal and ventral longitudinal muscles are less massive in proportion. Behind the middle of the body, again, the great increase of the ventral longitudinal muscles is a feature of note, the dorsal being comparatively small.

The first region of the body comprises from thirty to thirty-three bristled segments, the first and last being more or less modified. The strong ventral bristles of the region as a rule are somewhat paler than in *A. Cuvieri*, the stout ventral bristles of which are sometimes even dark brown.

The first segment is larger than the buccal, but less than those which follow. Like the rest the foot is dorso-lateral in position, the superior division indeed being wholly dorsal, and consisting of a tuft of transversely serrated (camerated) and finely tapered bristles with a cirrus behind and rather towards the outer border. The ventral division is dorso-lateral, and it has a cirrus and a long papilla with a group of the long tapering camerated bristles, and a series of strong and short curved forms with blunt tips generally smoothly rounded, and having spinous rows (abraded) on the shaft below. Many of these are arranged at an angle to the longer forms, and the shorter forms are ventral. The second foot has longer dorsal bristles and a longer and larger cirrus, whilst fewer long serrated bristles occur in the ventral division, which has three papillæ. The third foot has a few tapering serrated bristles superiorly and a thinly scattered series along the rest of the line. All are shorter than those in front. The stout abraded forms with the rounded ends and serrations on the convex edge of the curve (as on the tapering bristles) extend from the upper to the lower edge of the division. The upper papilla is longest (and may represent the cirrus), and seven shorter follow. The fourth foot has still fewer and shorter tapering serrated bristles, but the curved stout forms are more conspicuous. The one increases in strength as the other wanes.

The tenth foot has a much longer dorsal cirrus and a series of strong dorsal bristles. The ventral division has very short tapered forms here and there along the line, the whole length of which bristles with the stiff curved and serrated forms, the tips of which, moreover, are more or less acute. About fifteen papillæ occur along the line. The twentieth foot has a longer and denser tuft of dorsal bristles, and the cirrus has increased in size. The short tapering serrated bristles are still present along the line, whilst the curved spine-like forms are fully developed and thicker than in front. Many of the points are sharp, while others are rounded and blunt. The papillæ are more numerous, and the line is longer.

At the twenty-ninth foot the dorsal cirrus has assumed the form of a bellied knife, that is, whilst its inner edge (that next the branchia) is more or less straight, the outer springs from a broad base, curves outward, and then backward to the subulate tip. The row of the large curved yellow spines is now short, but traces of serrations are still visible, and the short serrated bristles accompany them. The papillæ are conspicuous, the longest being that next the dorsal division, and another a little to its exterior.

The knife-like shape of the dorsal cirrus is conspicuous at the thirtieth foot, and so is the great tuft of serrated (camerated) tapering bristles. Externally after an interval is a long cirrus-like papilla, and a somewhat shorter one to the exterior. Ventralwards little is seen except the row of papillæ but the tips of a few tapering serrated bristles at

and below the second or shorter papilla just mentioned. No strong spine-like forms can be observed. The dorsal division of the thirty-first foot is like the preceding, but the cirrus-like papilla to its exterior is larger, whilst its neighbour, also above noticed, has now assumed a conical outline, is much larger, and has a broad base, whilst a small tuft of long, slender, and finely spiked bristles projects from a furrow between a slight elevation and its base. The papillæ are present along the edge of the foot beneath, but all trace of the curved spine-like forms and short slender bristles has vanished.

The papillæ behind the feet pass down to form a continuous row from side to side for seven segments in front of the thirty-first, besides several imperfect rows before these, and for five segments behind the thirty-first.

The type of foot just described is modified only in a slight degree in its progress backward to the tail. Thus at the fortieth foot the cirrus next the dorsal division is longer, and the ventral setigerous process is bifid, whilst a ventral cirrus appears at its lower border. The dorsal bristles have forked bristles with probe-points and spinous inner edges amongst the others. The length of the ventral bristles has rather increased and the spikes on the tips are directed distally.

At the ninetieth foot the branchia has increased in size, whilst the dorsal cirrus is narrower and smaller.

In the feet some distance in front of the tail the branchia has notably increased in size, and the dorsal cirrus is still knife-shaped, the intermediate cirrus being filiform, as also is the tip of the long horn of the setigerous region and the ventral cirrus. The long and strong dorsal bristles are only faintly serrated with spikes distally, and the forked bristles continue. The tips of the ventral bristles are similar.

No noteworthy change occurs till the diminution of the parts at the tip of the tail.

In an example of this species procured in sand at low water, 15th June, 1904, there were respectively thirty-one and thirty-three of the anterior segments with the deep-brownish bristles. The eighth on the right, from injury, was out of line, and the seventeenth was double, also apparently the result of an injury. The rows of ventral papillæ began on the twentieth and continued to the thirty-fifth, at which the specimen abruptly terminated.

Reproduction.—In a female procured on 15th June the body ventrally and laterally was of a dull yellow or buff colour from the masses of dull yellowish eggs, which occurred in each segment. The eggs formed masses at the bases of the feet and were visible through the dorsal wall. Such a condition seems to be common at this time. In section the ova occupied not only the cœlomic space on each side of the alimentary canal, but passed on each side of the middle line between the dorsal longitudinal layer and the circular coat of the region.

Habits.—This species is a borer in sand, a life for which its mobile, pointed snout and the conformation of its elongated body adapt it. It is not easy, however, to secure perfect examples, especially if attempts are made to remove them from the hard sand. When lying free in the water they sometimes keep up an undulatory movement of the body as if for respiratory purposes.

[1] 'Mitth. Zool. Stat. Nap.,' xiii, p. 484.

4. Aricia Grubei, n. s. Plate LXXXV, figs. 8–8 *b*—bristles; Plate LXXXVI, fig. 1 —foot.

Specific Characters.—Head typical. Anterior region of fifteen bristled segments. Each foot has a dense tuft of camerated or spinose bristles finely tapered, with a stout dorsal cirrus posteriorly. An interval separates it from the ventral division, which has a series of similar but shorter bristles, many of which have shafts with rounded tips. The last three feet of the region have dark brownish spines with long hastate tips. The rows of papillæ posteriorly are separated by an interval from the bristles. These papillæ occur on the ventral surface of bristled segments thirteen, fourteen, fifteen, and sixteen, and it may be in one or two succeeding segments. The twenty-third foot has the broadly lanceolate branchia, then the elongated dorsal cirrus shaped like a pointed shoe, with a tuft of long serrated (camerated) bristles, amongst which are some simple forms. There are four spines. In the interval between this and the ventral division is a short and rather broad conical papilla or cirrus. The ventral division has a somewhat clavate setigerous region supported by two spines, and a pointed lanceolate lobe attached to it distally and projecting in front of it. The ventral cirrus forms a broad process, sometimes with a pointed tip to the exterior of its base at the twenty-third foot. The dense bristles of the dorsal division anteriorly are transversely spinous or camerated forms; those in the upper series of the ventral division are shorter, but of similar structure mixed with broken shafts with rounded tips like stout spines. The last three anterior feet have four dark-brownish hastate spines. At and after the twenty-third foot slender tapering serrate (camerated) bristles, a few simple bristles, and four spines are found dorsally, whilst the ventral division has a few very slender bristles with minutely spinose tips, but none were perfect.

Habitat.—Dredged in the 'Porcupine' Expedition of 1869 in 422 fathoms on a bottom of sand, stones, and coral. 'Porcupine' Expedition of 1870 at Station VI in 358 fathoms; and at Station VIII in 257 fathoms.

The proboscis is extruded as a foliaceous button.

A comparatively small form, with the typical arrangement of snout anteriorly, and about fifteen of the largely developed anterior feet with vertical rows of ventral bristles. The anterior feet, *e.g.*, the tenth (Plate LXXXVI, fig. 1), have a dense tuft of camerated bristles finely tapered (Plate LXXXV, fig. 8) and a stout dorsal cirrus, then an interval devoid of appendages. The inferior division has a more or less complete series of similar though shorter bristles, and also of broken shafts with rounded tips, more or less modified so as to perform the functions of stout spines (Plate LXXXV, fig. 8 *a*), whilst the majority of the anterior feet have pale or slightly yellowish bristles in the inferior division; the last three have about four dark brownish hastate spines with long tips (Plate LXXXV, fig. 8 *b*). The row of papillæ behind these feet is separated by a considerable interval from the bristles, so that the foot has a character of its own. Rows of papillæ occur on the ventral surface of bristled segments thirteen, fourteen, fifteen, and sixteen, and it may be partially on one or two others behind.

The change in the form of the foot takes place about the seventeenth, and at the

twenty-third the foot has dorsally on each side of the median line the broadly lanceolate branchia, then the elongated dorsal lobe, which is shaped somewhat like a pointed shoe, with a tuft of slender, tapering, serrate (camerated) bristles, amongst which are some simple forms, and with four spines. In the interval between this and the ventral division is a short and rather broad conical papilla. Then the bifid ventral lobe follows with a somewhat clavate setigerous region supported by two spines, and a pointed lanceolate lobe in front of it. The bristles were almost wholly abraded, but such as remained conformed to the elongated slender forms with finely tapered tips and minute serrations directed distally.

At the base of the ventral division is a bluntly pointed lamella apparently homologous with the ventral cirrus.

No forked bristles were observed, but the condition of the examples was not favourable.

This form, therefore, differs from the *Aricia Kupfferi* of Ehlers in the occurrence of a short cirrus between the dorsal and ventral lobes, though it also has hastate spines in the last three feet of the anterior region. It likewise differs from *A. norvegica* in having the intermediate cirrus, and in the shape of the ventral cirrus.

5. Aricia norvegica, *M. Sars*, 1873. Plate LXV, fig. 3—head; Plate LXXXV, figs. 9–9 *b*—bristles; Plate LXXXVII, figs. 2 and 2 *a*—feet.

Specific Characters.—Head a short cone as in the type. Anterior region of the body has fifteen bristled segments. Branchiæ commence on the fifth. Dorsal cirrus flattened, slightly enlarged towards the base, and tapered distally. Anterior rows of ventral bristles pale, the last three or four feet with dark brown hastate spines. Rows of papillæ behind the foot more acutely pointed than in the previous forms, and eight to twelve in number (Sars). Form and colour as in *A. Cuvieri* (Sars). At the twenty-third foot the dorsal division has four or five spines and a long tuft of slender bristles with finely tapered serrated tips. The cirrus is narrow and has a tapered extremity. The ventral division has one spine and a small group of equally slender bristles, the tips of which are serrated. The blunt setigerous lobe has a conical lobe to its outer side, whilst at the base externally is a conical ventral cirrus nearly equal in size to the last mentioned.

Synonyms.

1871. *Aricia norvegica,* M. Sars. Vidensk.-Selsk. Förhandl. for 1871, p. 5 (sep. copy).
1873. „ „ idem. Bidrag Christ. Fauna, iii, p. 36, Tab. xvi, f. 1—8.
1874. „ „ Malm. Göteb. vet. o. vitt. Handl., xiv, p. 91.
1875. „ „ Möbius. Jahresb. Comm. deutsch. Meere, p. 160.
1877. „ *grœnlandica,* McIntosh. Trans. Linn. Soc., Zool., i, p. 504, pl. lxv, f. 5—9.
1879. „ *norvegica,* Tauber. Annul. Danic., p. 106.
„ „ „ Hansen. Nyt Mag. f. Naturvid., xxiv, p. 269.
1893. „ „ Levinsen. Vidensk. Ud. "Hauchs," p. 336.
1905. „ „ McIntosh. Ann. Nat. Hist., ser. 7, vol. xv, p. 44.

Habitat.—St. Magnus Bay, Shetland (J. G. Jeffreys).

Dröbak, Norway (Sars). Station XLVII, off the coast of New York ('Challenger'), at the great depth of 1340 fathoms in blue mud. Also in 1200 fathoms off Rio, San Francisco, in mud. Jan Mayn (Hansen). Variety from the 'Valorous' Expedition, 1875. Bergen, Norway (Canon Norman).

Head (Plate LXV, fig. 3) a short cone as in other species.

Body typical in outline. The anterior region consists of fifteen bristled segments (Sars says fifteen to sixteen). The branchiæ commence on the fifth bristled segment. The general aspect of this (anterior) region differs from that of the allied species (1) in the flattened condition of the dorsal cirrus, which occasionally has a filiform process at its outer edge; (2) by the pallor of the anterior rows of ventral bristles and the large dark brown spines of the last three or four; (3) by the more acutely pointed papillæ in the row behind the foot (ventral division) and the tendency to show a larger area of bristles and flap. Along the dorsum is a series of brownish dots at the segment-junctions, but these were not observed in the spirit-preparations.

The proboscis forms a frilled button like a rosette, the folds passing to the central aperture.

The first foot has two papillæ, each with a short tuft of tapering camerated bristles. The foot is thus bifid from the commencement, a condition not always seen in allied families. At the tenth foot (Plate LXXXVII, fig. 2) the dorsal cirrus has a broadly lanceolate outline with a long tip, and the shafts of the long bristles are smooth, the tapering tips being camerated (Plate LXXXV, fig. 9). The bristles of the inferior division form a dense series, and are short, tapering, and camerated. The posterior papillæ have tapered tips. The twelfth, thirteenth, fourteenth, and fifteenth feet show numerous dark brown hastate spines (Plate LXXXV, fig. 9 *a*); the posterior papillæ are sometimes bifid. One of the spines (the upper) usually projects freely.

Amongst the dorsal bristles are some bifurcate spinous forms (Plate LXXXV, fig. 9 *b*).

The anterior branchiæ form broad, tapering, flat processes, nearer each other than behind, where they are considerably longer and narrower, and leave much of the dorsum bare. Posteriorly they greatly increase in length and have filiform tips.

At the twenty-fifth foot, which shows the average condition after the change, a considerable interval occurs between the branchia and the dorsal division, which has four or five spines and a long tuft of slender bristles with very finely tapered smooth tips. The cirrus is narrower and has a long tapered extremity. The ventral division has one spine and a small group of equally slender bristles, the tips of which, however, are serrate. The blunt setigerous lobe has a conical lobe to its outer side, whilst at its base externally is a ventral cirrus, also of a conical outline and approaching the former in size.

Tauber[1] (1879) appears to think that the *Aricia Kupfferi* of Ehlers is a variety of this form, which certainly agrees with it in the absence of the cirrus between the dorsal and the ventral divisions of the foot. Both have a similar ventral cirrus, and the general characters agree except that the ventral surface of *A. norvegica* has no rows of papillæ, whereas that of *A. Kupfferi* has. The absence of the intermediate cirrus just referred

[1] 'Annulat. Danic.,' p. 106.

to is characteristic of *A. fœtida* of the Mediterranean, as well as of a fragmentary form from Malahide.

The *Aricia grœnlandica*[1] of the cruise of the 'Valorous' appears to be a variety of this species.

6. Aricia Armandi,[2] n. s. Plate LXXXVII, figs. 19 and 20—feet.

Specific Characters.—Snout somewhat truncated (?). Body, so far as known, of the typical outline; anterior region of nineteen segments, and the ventral spinous areas are pale yellow. Branchiæ arise on the fifth foot. Foot differs from *A. Cuvieri* in the absence of the cirrus between the dorsal and ventral divisions, and in the great length of the papillæ in the ventral rows. From *A. Kupffери* and *A. norvegica* the species diverges in the number of the anterior segments, and in the form and arrangement of the papillæ behind the ventral division of the foot, and on the ventral surface of certain segments.

Habitat.—Dredged in St. Magnus Bay, Shetland, in eighty fathoms, by Dr. Gwyn Jeffreys in 1868.

The specimen is in a softened and fragmentary condition, so that the condition of the head is unsatisfactory. The snout is truncated, the tip of the usual cone being absent, but whether this is natural or due to injury is uncertain.

The anterior region of the body, which is of comparatively small size, consists of nineteen segments, though the softened state of the parts gives insecurity as to a segment in front. The ventral spinous areas are of a pale yellow hue. The general outline is of the normal type, but only the anterior region and a portion of the succeeding about the same length are present. The branchiæ appear to arise on the fifth foot. The long papillæ are continued a short distance downward at the seventeenth foot and pass nearer the middle line on the eighteenth, nineteenth, and twentieth feet, diminishing again on the succeeding two or three feet, the region thus having a remarkably hirsute aspect from their comparatively great length.

The first foot is injured dorsally, only a tuft of long, slender, serrated bristles remaining. The ventral division has a short row of spine-like stumps of the moderately strong serrated bristles with the tips smoothly rounded, whilst the edge of the bristle beneath is faintly serrated. A few tapering serrated bristles of moderate length are likewise present along the row. At the ninth foot the dorsal cirrus seems to be of moderate length, and the dorsal bristles are long, serrated (camerated), and tapered. The upper process of the ventral division is longer than the others and cirrus-like, a considerable interval occurring between it and the dorsal division. A dense series of strong spine-like bristles occurs along the edge, the upper being stouter than the lower. Each is a stout process, curved at the tip, which is smooth and blunt. No trace of the serrated edge beneath is now seen. By transmitted light they are dull yellow. A few serrated tapering bristles are in the row bounded posteriorly by the papillæ, which are

[1] 'Trans. Linn. Soc., Zool.,' vol. i, p. 504, pl. lxv, figs. 5—9, 1877.

[2] Named after M. Armand De Quatrefages, who for many years was the leading authority on the Annelids in France.

large and tapered, and project considerably beyond the spines. Little change occurs at the sixteenth foot except that the bent tips of the spines towards the middle and lower part of the row are slightly clavate, that is, bluntly rounded and somewhat enlarged. The posterior papillæ are still tapered and rather long. The seventeenth and eighteenth feet are similar, but have fewer bristles, thus making a shorter row. A few short, tapering, serrated forms are also present; moreover, there are a few bifid forms with the limbs well separated and with a mucro at the tip, their inner edges being spinous. They radiate from a narrow base, as the long bristles do, only their tips are curved and modified for special service. The dorsal cirrus is elongate-lanceolate, the tips of the bristles being serrated (camerated), whilst the long shaft is smooth. The papillæ are very conspicuous, and at the nineteenth foot they have the margin of the division to themselves, for the stout and modified spine-like bristles are few and project little, whilst near the upper edge of the ventral division a few very slender and apparently smooth bristles with finely tapered tips project. Amongst these is a short (broken ?) slightly bent shaft with a rounded tip. These bristles would appear to be modified by their surroundings, as well as by the adaptability of the tissues which form them. The dorsal cirrus is a conspicuous flattened process, and the dorsal bristles are longer, the whole foot initiating the change, though the projection of the spinigerous lobe is scarcely marked, At the twenty-third foot the alteration is complete, the large branchia being internal, then follows the somewhat subulate dorsal cirrus, with a slight enlargement on its external edge, and the long dorsal bristles with slight serrations on their finely tapered tips, accompanied by a few bifid forms. The ventral lobe is clavate, bifid at the tip, the shorter process being rounded and containing the spine, whilst the other (ventral) forms a considerable subulate appendage. The bristles are few, slender and tapering, scarcely a trace of serrations being visible. The ventral cirrus is a subulate process resembling the appendage above it.

Whilst approaching *Aricia Cuvieri* this form differs in the number of the anterior segments, the absence of the cirrus between the dorsal and ventral divisions, and in the great length of the papillæ in the ventral rows. The number of the anterior segments likewise differentiates it from *A. Kupfferi* and *A. norvegica*, as also do the form and arrangement of the papillæ behind the ventral division and on the ventral surface of certain segments.

Genus LXXVIII.—Scoloplos (*Blainville*), *Œrsted.*

Head pointed, peristomial segment a blunt cone. Proboscis a foliate rosette. Body widened anteriorly, flattened, diminishing posteriorly, and ending in a vent with four papillæ and two cirri. Regions of the body two, anterior and posterior; the former with the feet lateral, the latter with the feet dorsal. Branchiæ dorsal, ligulate, decreasing in size posteriorly and disappearing. Inferior division of the foot in the anterior region with a small papilla. Long, tapering serrated dorsal bristles, and stout, serrated spine-like bristles ventrally. In the posterior region the bristles are all slender and serrated. The structure of this type generally approaches that of *Aricia*, though the rows of papillæ on the feet are absent.

Scoloplos armiger, *O. F. Müller*, 1788. Plate LVI, fig. 7; Plate LXV, figs. 4 and 4 *a*—head and tail; Plate LXXXVI, figs. 1 and 1′—bristles; Plate LXXXVII, figs. 4–4 *b*—feet.

Specific Characters.—Head an acutely pointed cone set on the larger truncated cone of the peristomial segment. Often with deep-seated dark specks at the base. Body flattened and widened anteriorly, then rounded ventrally, and flattened dorsally in its progress to the tail, which ends at the vent surrounded by four papillæ, whilst on each side is a long slender cirrus. Anterior region of about eighteen segments with lateral feet, having shorter, stouter, serrated bristles. The fifteenth foot is composed of a conical dorsal cirrus or lobe, with, in front of it, a tuft of rather long bristles, the shafts of which are smooth. The tapering tips are peculiarly spiked and end in smooth, hair-like points. The ventral division has two short conical papillæ, one of which is below the bristle-tuft and probably represents the ventral cirrus, whilst the other is behind the middle of the dense, deep row of bristles, which are shorter than the dorsal but of the same type. Feet posteriorly are dorsal, the branchia being nearest the middle line, then follows the dorsal cirrus of the shape of a bellied knife and about half the length of the branchia, and lastly the dorsal fascicle of serrated bristles. The ventral division is a little shorter and boldly bifid, the upper process being the longer. The small group of slender bristles emerges between them.

Branchiæ commence in the form of a small papilla on or about the seventeenth bristled foot, attain considerable size on the twentieth foot, and almost reach the tip of the tail. Below the foot from the eighteenth bristled segment to the thirtieth (fewer in some) a papilla occurs on the side of the body.

Synonyms.

1788. *Lumbricus armiger,* O. F. Müller. Zool. Danica, i, p. 22, Tab. xxii.
1828. *Scoloplos* „ De Blainville. Dict. Sc. Nat., lvii, p. 493.
1842—3. „ „ Œrsted. Kroyer's Nat. Tids., p. 125.
1843. *Aricia Muelleri,* H. Rathke. Nova Acta Leop.-Car., xx, i, p. 176, Tab. viii, f. 9—15.
„ *Scoloplos armiger,* Œrsted. Annul. Danic. Consp., p. 37, f. 8.
„ „ „ idem. Grönl. Annul. Dorsibr., pp. 106, 107, 109, 201, f. 113, 117, 118.
1844. „ „ idem. Arch. f. Naturges., x, i, p. 104.
„ „ „ idem. Regionis Marinis, p. 78.
1844—5. „ „ idem. Kroyer's Nat. Tids. (Dröbak), p. 412.
1851. *Aricia armigera,* Grube. Fam. Annel., pp. 68 and 135.
1853. „ „ Sars. Nyt Mag. f. Naturvid., vii, p. 381.
1856. „ „ Koren. Ibid., ix, p. 95.
1858. „ *armiger,* Danielssen. Reise, 1857, p. 53.
1859. „ „ idem. Ibid., 1858, p. 129.
1865. „ *armigera,* De Quatrefages. Annel., ii, p. 286.
1867. *Scoloplos armiger,* Malmgren. Annul. Polych., p. 72.
1869. „ „ McIntosh. Rep. Brit. Assoc. (1868), p. 338.
1870. „ „ Grube. Arch. f. Naturges., xxxvi, p. 316.

1871. *Scoloplos armiger*, Möbius. Bericht. Exped. 'Pommerania,' p. 197.
„ „ „ Ehlers. Sitz. Phys.-Med. Soc., Erlangen., iii, p. 79.
1873. „ „ Sars. Nyt Mag. f. Naturvid., xix, p. 240.
„ „ „ Möbius. Jahresb. Comm. deutsch. Meere, p. 107.
1874. „ „ idem. Die Zweite deutsch. Nordpol., p. 255.
„ „ „ Malm. Göteb. vet. o. vitt. Handl., xiv, p. 91.
„ „ „ McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 200.
1875. „ „ idem. Invert. and Fishes St. Andrews, p. 124.
„ „ *armiger*, Möbius. Jahresb. Comm. deutsch. Meere, 1874, p. 160.
1877. „ „ Hansen. Nyt Mag. f. Naturvid., xxiv, p. 6.
1878. „ „ Lenz. Jahresb. Comm. deutsch. Meere, 1874—5, p. 11.
„ „ „ McIntosh. Trans. Linn. Soc., Zool., i, p. 504.
1879. „ „ Hansen. Nyt Mag. f. Naturvid., xxiv, p. 6.
„ „ „ Théel. K. sv. vet. Akad. Handl., Bd. xvi, No. 3, p. 45.
„ „ „ Tauber. Annul. Danic., p. 106.
1881. „ „ (acoustic capsules), Mau. Zeitschr. f. wiss. Zool., Bd. xxxvi, p. 389, pl. xxvi and xxvii.
1882. *Aricia arctica*, Hansen. Nord. Nordhav. Exped., vii, p. 34, Tab. v, f. 20—26.
1883. *Scoloplos arctica*, Wirén. Chæt. 'Vega' Exped., p. 405.
1888. „ *armiger*, Cunningham and Ramage. Trans. Roy. Soc. Edin., p. 200, vol. xxxiii, p. 642, pl. xxxviii, f. 7.
1889. *Aricia armigera*, Marenzeller. Arch. f. Naturges., lv, p. 132.
1891. „ „ Hornel. Trans. Biol. Soc. Liverp., vol. v, pp. 249 and 252.
1894. *Scoloplos armiger*, De St. Joseph. Ann. Sc. nat., 7e sér., t. xvii, p. 94, pl. v, f. 119—120.
1897. *Aricia armigera*, Birula. Ann. Mus. Zool. l'Acad. Imp. St. Pétersb., p. 21.
1898. „ *Mülleri*, De St. Joseph. Ann. Sc. nat., 8e sér., t. v, p. 356, pl. xx, f. 167.
1901. *Scoloplos canadensis*, Whiteaves. Geol. Surv. Canada, No. 722, p. 79.
1904. „ *armiger*, Allen. Journ. M. B. A., n.s., vii, p. 227.
1905. „ *Mülleri*, McIntosh. Ann. Nat. Hist., ser. 7, vol. xv, p. 45.
„ „ *armiger*, idem. Ibid., p. 54.
1909. „ „ Moore. Proc. U.S. Nation. Mus., vol. xxvii, p. 139.

Habitat.—Abundant between tide-marks at Lochmaddy, North Uist, and also dredged on a sandy bottom in the Laminarian region. On a sandy bottom at Paible, North Uist, in four to five fathoms. In the sandy mud of the bathing pond at the Step-Rock, St. Andrews. Dredged in four to five fathoms and also in fifty fathoms off Balta, July, 1867 (J. G. Jeffreys). Common in Herm, in sand between tide-marks, August, 1868, and in a similar region in Cobo Bay, Guernsey. Off Symbister Harbour, Whalsey, Shetland, in three to five fathoms, July, 1871. Fragment from Malahide, Co. Dublin (A. C. Haddon).

Extends to Finmark (A. M. N.); Baltic (Mau); Nova Zembla (Théel); and to Canada (W. C. M.); Labrador (Moore); Greenland (Œrsted); and 1100 fathoms in 'Valorous,' 1875. Siberian Coast (Wirén). Northern seas generally (Malmgren).

Head (Plate LXV, fig. 4) forms an acutely pointed cone without rings or subdivisions, though when actively thrust amongst the surrounding structures it frequently presents crenations at the edges. In some, four deep-seated dark specks occur in front of the mouth arranged in a crescent, the posterior pair being nearest each other. In others there is less definition, the dark specks (often two) being irregular. It is doubtful if these are eyes.

The peristomial segment follows as a larger truncated cone. According to the degree of extrusion of the proboscis a rounded or a somewhat cylindrical process projects from the mouth, or a foliate rosette of six or seven lobes, like those of *Anthostoma*, lie over (*i.e.* beneath) the mouth.

Body 3 to 6 or more inches in length, flattened and widened in the anterior region before tapering to the pointed snout. Behind this anterior region the body is rounded ventrally and flattened dorsally, and it continues so to the tail. The segments are distinctly marked. Colour of a deep but not a bright red, inclining to orange posteriorly. Others are of a general orange colour. The dorsum has a bluish-green iridescence anteriorly. In ripe males the posterior region is cream-coloured. The body diminishes considerably posteriorly and terminates at the vent, the rim of which apparently is divided into four papillæ, whilst on each side is a long slender cirrus. In an example from Symbister Harbour, Whalsey, Shetland, the tail (Plate LXV, fig. 4 *a*) has in addition to the papillæ (four) two other processes besides the cirrus, but as this tail had been reproduced the exact nature of these additional processes is uncertain, and they may have been abnormal. In another example from the same site the tail corresponded with the type, viz., had four small lobes or papillæ and two long cirri. These cirri show peculiar hypoderm, the granules and cells towards the tip often being isolated. In all the slender posterior region has proportionally much longer branchiæ and foot-processes, so that it is hispid or fringed in a characteristic manner.

The muscularity of the body-wall anteriorly is great, the vertical and transverse muscles being apparently strong. As soon as the nerve-cords reach the ventral surface they lie under a broad band of muscle continuous in the middle line and apparently homologous with the oblique muscles. When the body-wall is completely formed the disproportion between the dorsal and ventral longitudinal muscles is great. The dorsal are comparatively thin and narrow, whereas the ventral form nearly half the area of the body in section. Each is a massive muscle stretching almost to the dorsal edge of the body, and increasing in diameter to the mid-ventral line, where it is deepest. The nerve-cords are carried inward, and are connected with the hypoderm only by a very narrow pedicle. The area is ovoid, with a large neural canal superiorly. The inner border of each muscle often separates along with the nerve-area in section, a condition which, perhaps, occurs more easily from the fan-like series of fasciculi, which traverse the muscle from the great vertical band on each side of the gut. The oblique muscles, which are fairly developed, are fixed to the outer edge of the upper arch of the area.

Very fine examples from Lochmaddy, North Uist, have the median ridges of segments running from the feet ventrally well developed, especially posteriorly. In a specimen from Balta (four to five fathoms) the lateral fillets below the ventral division of the foot are tinted brownish in the spirit-preparation, as if from pigmentary deposit, from the twenty-first foot to the fifty-first, the end of the fragment.

The anterior region consists of about eighteen segments, having shorter, stouter, serrated bristles. The feet are little developed, though from the first segment backward two bristle-bundles, which soon assume distinct characters, are present. Thus at the fifteenth foot the dorsal division has a conical dorsal cirrus of considerable size, whilst in front of it, and arising from a rounded elevation, is a tuft of rather long bristles, the shafts

of which are smooth (Plate LXXXVI, figs. 1 and 1′), but the tapering tips are peculiarly spiked, and they terminate in smooth hair-like points. Four somewhat short spines support the bristles. The ventral division has two short conical papillæ, one of which is below the bristle-tuft, and is probably the representative of the ventral cirrus, whilst the other is a little below the middle of the bristles, which form a dense and deep row, shorter than the dorsal but of the same type. At the ninth foot, however, the papillæ are smaller, and the inferior division has numerous short strong bristles with somewhat blunt tips, which are strongly curved and serrated on the convex side. They are modified forms of the longer series, and correspond with the stronger series in *Aricia*. The same is seen in the tenth foot (Plate LXXXVII, fig. 4).

The branchiæ commence in the form of small papillæ from the fifteenth to the seventeenth foot, attain considerable size on the twentieth foot, rather increase in proportional length in their progress backward, and almost reach the tip of the tail.

Below the foot from the eighteenth bristled segment to about the thirtieth (fewer in some) a papilla occurs on the side of the body. It varies in prominence, it may be in some cases from preparation, and is very well marked in Zetlandic examples from Symbister. This feature is variable. Thus, in an example from Lochmaddy the papilla appears on the seventeenth bristled segment. At the twenty-fourth and twenty-fifth it has become scale-like, and adheres to the front edge of the ridge from the foot.

The eighteenth bristled foot shows considerable alteration. Externally, that is, ventrally, is a small papilla, then a bifid process with the bristles. The dorsal division consists of a longer conical papilla with a fan-shaped tuft of bristles. The ridge of the segment below the feet also becomes more prominent in this region.

At the twentieth foot (Plate LXXXVII, fig. 4 *a*) the ventral division presents a somewhat lanceolate outline, and the bristles are slender and almost smooth. The dorsal papilla is constricted at the base, then dilated, and slightly tapered to the tip. It bears a fan-shaped tuft of long bristles, with smooth shafts and tapering serrated tips. It adjoins the branchia.

The thirtieth foot (Plate LXXXVII, fig. 4 *b*) has ventrally a bifid setigerous region, with a rounded enlargement at the base ventrally. The bristles are few, long, slender, and very finely serrated—quite different in aspect from the dorsal. The dorsal lobe is constricted at the base, with a lanceolate terminal region tapering to a point. The bristles have smooth shafts and boldly serrated tips. The branchia is a richly ciliated, flattened lanceolate organ, with central vessels which apparently have pinnate lateral branches.

Cunningham and Ramage figure [1] a bifid bristle as occurring in this species, where, it is not stated. A mistake may have happened, especially as the inner edge of the fork is smooth.

On the whole, while there are certain differences in the proportional length of the

[1] 'Trans. R. Soc. Edin.,' vol. xxxiii, pl. xxxviii, fig. 7 *e*. This recalls the case of a foreign observer, who showed this kind of bristle in another species in a proof of the plate. The absence of these spikes was pointed out, the author asserting that the limbs of the fork were smooth. When the paper and its plates subsequently appeared the spikes had taken their proper places.

dorsal cirri and the papillæ anteriorly, as well as variations in the length of the bristles, specific separation of the northern and southern representatives does not seem to be necessary or expedient. The following remarks will indicate the leading features relating to the varieties:—

The variety *Mülleri* (the *Aricia Mülleri* of De St. Joseph) is characterized by the frequency of shorter bristles in the anterior feet—such bristles as are represented by De St. Joseph in his figure 167, Plate XX. The structure thus figured and described, however, might be explained by the occurrence of injury to the tapering bristles and the rounding of the broken tips. As formerly observed,[1] they are modifications of the longer series, not structures *sui generis*, and are apparently due to influence of habitat, *e.g.*, constant friction, and they vary much amongst themselves. De St. Joseph has the credit of drawing special attention to them, and to the fact that in the first six segments of the posterior region of the body the ventral division has two protuberances below it, with a minute elevation near them, and a conical papilla on the body below. It is not explained that a similar papilla occurs in the typical *Scoloplos armiger* from Greenland and the northern waters. The two forms very closely resemble each other, the main features which differentiate them being the somewhat longer rows of bristles in the southern form, and the better developed fleshy ridge behind them with its flattened conical elevation in the ventral division, and the two papillæ just below it; whilst the ventral row of bristles has a variable number of short and somewhat truncate forms, which must not, however, be regarded as specific. They are only modified forms of the ordinary tapering serrate kind belonging to the division, and, as stated, are probably due to circumstances of habitat, and are perhaps more abundantly present in those from the Channel Islands than in the more northern examples. In this form a papilla appears in the middle of the fifth foot, and a conspicuous one from the tenth to the thirteenth. At the seventeenth foot two papillæ occur, by the addition of one below the median, whilst the eighteenth has three, the bristles being above (dorsal to) the upper. At the nineteenth foot the lateral ridge ends dorsally in three conical processes, with a thick papilla beneath. In very fine examples from Lochmaddy the papilla commences on the fifteenth, and continues to the twenty-second foot.

In the typical *Scoloplos armiger* from Greenland, the first fifteen anterior feet have somewhat shorter (*i.e.*, from above downward) ventral rows of bristles. The dorsal cirrus is a well-marked conical process, which gradually increases in length posteriorly. The fillet behind the ventral row of bristles forms a convex flap, highest in the middle, and without any evident differentiation till the fifteenth foot, where a papilla projects from its median convexity, one or two of the preceding feet showing a slight thickening at the same part. The row of ventral bristles is shorter. Though the bristles are longer, the row is still shorter at the sixteenth foot, and a papilla occurs on each side behind it. The seventeenth foot has three papillæ, whilst the eighteenth has the enlarged lateral fillet with an isolated papilla below it, and this for three or more segments. A survey of a series of specimens from Greenland shows considerable variations in the second division of the body in the shape of the dorsal cirrus, which may be fusiform or lanceolate and stalked, and in the length of the bifid ventral lobe. Yet these and other features are

[1] 'Ann. Nat. Hist.,' 7th ser., vol. xv, p. 45.

found in those from St. Andrews, Lochmaddy, the Channel Islands, and Shetland. These minute differences, and especially those mentioned by De St. Joseph, indicate the slender grounds on which specific distinctions may be founded.

Reproduction.—Hornel (1891) on 2nd March procured, on a sandy beach at Egremont, small gelatinous pear-shaped brownish egg-masses, the annelid being in close proximity to them. The brownish cocoons are smaller than the green ones of *Arenicola*, and are anchored amongst the bare ripple-furrows of the sand, the cylindrical stalk descending two or three inches into the sand. He watched their development, and corroborates Cunningham and Ramage,[1] who found the gelatinous transparent cocoons with opaque white eggs and embryos in the estuary of the Forth at low water in February. The larvæ had three transverse bands of cilia, a well-developed prostomium with two eyes, and by-and-by a pair of anal cirri as well as dorsal cirri appear. Similar cocoons and eggs were found by Leschke[2] in Kiel Bay in May. Late larvæ are found from July to September at St. Andrews (1890).[3]

Garstang,[4] again, mentions February as the breeding season at Plymouth.

The males are distinguished in January, when the body is distended with ripe sperms, by the cream-coloured posterior region.

In January the females are recognized by their buff-coloured bodies filled with similarly tinted ova, which, though far advanced, vary considerably in size—probably because they are in different stages.

Habits.—When removed from their haunts in the sandy mud they push their finely pointed snouts ceaselessly around it, and often coil their bodies into a spiral. If a little sand is in the vessel it is soon transformed by the aid of the mucus into a central mass permeated by the bodies of the examples, while the heads are pushed in various directions. Their food seems to be the sandy mud in which they dwell.

O. F. Müller gave the anterior region seventeen segments, and he found the species in mud. To what group the *Lumbricus squamatus*[5] of Abildgaard belongs is doubtful. It may be one of the Spionidæ.

Audouin and Edwards[6] describe an *Aricia sertulata* which is probably synonymous with O. F. Müller's *Lumbricus armiger*.

Œrsted[7] (1843) gives the anterior region fifteen segments with dark bristles. In the succeeding segments the ventral pinna is bifid, the superior acuminate, and the ligulate branchiæ thrice as long, the ciliated margin regularly decreasing and finally vanishing towards each end of the body. Subulate bristles in all the segments. Tail truncate without cirri. In this description there is not much at variance with the common British examples, for considerable variation occurs in the number of the anterior

[1] 'Trans. R. Soc. Edin.,' vol. xxxiii, p. 651, pl. xl, figs. 14A—14F, 1888.

[2] 'Wiss. Meeresuntersuch.,' vii, p. 126, 1903.

[3] 'Ann. Nat. Hist.,' 6th ser., vol. vi.

[4] 'Journ. M. B. A.,' vol. iii, p. 225.

[5] 'Zool. Danica,' iv, p. 39, Tab. clv, figs. 1—4.

[6] 'Ann. Sc. nat.,' 1e sér., t. xxix, p. 399. See also De Blainville, 'Dict. Sc. Nat.,' xxxiv, p. 450, and lvii, p. 483.

[7] 'Annul. Dan. Consp.,' p. 37, figs. 8, 106, 107, 109.

segments, and it only needs the effect of friction to alter the form of the anterior ventral bristles. Too rigid adherence to Œrsted's[1] description would give neither papillæ nor cirri to the tail.

Mau (1881) furnishes a detailed account of the body-wall, bristles, circulatory, nervous, muscular, digestive, and reproductive systems, and enables a comparison to be made with southern examples. Certain corrections are necessary in regard to the nerve-trunks, but he pointed out the position of the segmental organs which are at the base of the ventral division of the feet.

There is little in the description of Hansen's[2] *Aricia arctica* from Jan Meyen to distinguish it from this species.

Genus LXXIX.—Nainereis, *De Blainville*, 1828.

Head button-shaped. Body of two regions, slender and elongated, terminated by two rounded dorsal papillæ and two short ventral cirri. Branchiæ commence on the sixth foot and continue nearly to the posterior end. The structure of the foot in the second region is less complex than in *Aricia*.

The generic description of *O. Fabricius* was:—*Nais*, furnished with bifid lateral processes, abdominal cirri, and a quadrifid tail. By subsequent authors, such as Malmgren, the title was altered to *Naidonereis*, but there seems to be no special reason why the original name of De Blainville should not be retained.

The arrangement of the nerve-cords anteriorly seems to be similar to that in *Aricia* and *Scoloplos*, and they take position under the raphe, where the circular bands and oblique muscles meet. The muscles of the body-wall do not show the disproportion so characteristic of the species just mentioned, for the ventral are only a little larger than the dorsal. On the other hand the oblique and vertical are very strong, both uniting in the median raphe over the nerve-cords, which are at the inner end of a short, broad area passing inward from the hypoderm. In the middle of the body this area has externally the cuticle, then a somewhat thick hypodermic coat, which in the middle line presents a symmetrical arrangement of its cells and areolæ. Across the inner border of this coat pass fibres—probably from the circular coat (unless the basement tissue, which is not visibly differentiated, has them). Other fibres from the circular coat clasp the inner borders of the longitudinal layer. Deeply stained cells occur next, and then the nerve-area with its rounded cords and a neural canal superiorly in the middle line.

A new genus (*Theodisca*) was founded by Fritz Müller for Ariciidæ, with strap-like branchiæ, and biramous feet with the ventral division bilobed. The proboscis is extruded as a five-lobed foliaceous button. So far as can be observed all the known forms may readily be placed under *Nainereis*.

An allied group is the Levinséniens of Mesnil and Caullery. The prostomium has a median tentacle, as in Aricidea, and this is always absent in the Ariciidæ proper, which have a palpode. In the Ariciidæ the first body-segment is achetous, the branchiæ com-

[1] 'Annul. Dorsibranch.,' p. 201, figs. 115, 117, 118.

[2] 'Norske Nord.-Exped.,' 1876—8, vii, p. 34, Tab. v, figs. 20—26.

mence on one of the twenty anterior segments, but are rudimentary anteriorly, and gradually increase. In the Levinsénians they begin on the fourth setigerous segment and only occur on a certain number of anterior segments, whereas in the Ariciidæ they extend to the posterior end, and their insertion is more dorsal than in the Levinsénians, which, moreover, have more simple feet, with a dorsal and a ventral cirrus, though the latter is often absent. The bristles are not annulated in the Levinsénians. They have three anal cirri, whereas the Ariciidæ have two or four. The proboscis is less complex than in the Ariciidæ and there is no œsophageal cæcum. The ventral nervous system is intra-epidermic, whereas in the Ariciidæ it is intra-cœlomic.

Mesnil and Caullery[1] place *Theodisea* under the sub-genus *Nainereis*, Blv., of the genus *Aricia*, Aud. and Edw. They enter *T. anserina*, Clap., Port Vendres; *T. liriostoma*, Clap., Naples; *T. mamillata*, Cun. and Ramage (Claparède?). In this group the prostomium is rounded. Lo Bianco puts *Nainereis* as a synonym of *Theodisca*.

It is understood that Dr. Eisig is at present engaged with the Ariciidæ, and is of opinion that the genus *Theodisca* of Fritz Müller is unnecessary, and that the old genus Nainereis (*Naidonereis* of others) including *N. quadricuspidata*, seems to be sufficient for the known forms.

1. Nainereis quadricuspida, *Fabricius*, 1780. Plate LXV, figs. 5 and 5 *a*—head; Plate LXXXVI, figs. 2–2 *b*—bristles; Plate LXXXVII, figs. 5–5 *b*—feet.

Specific Characters.—Head forming a rounded button-shaped process set on the peristomial segment, which is notched at each side. Body about 3 ins. in length, slightly tapered in front and considerably diminished towards the tail, which ends in two rounded dorsal papillæ and two short ventral cirri. Anterior region of thirteen bristled segments. Branchiæ commence on the sixth foot and continue of comparatively large size till the eighth or tenth segment from the tip of the tail. At the tenth foot the branchia is flattened and acutely lanceolate, and it is separated by a space from the dorsal division of the foot, which bears a fan-like tuft of tapering bristles with smooth shafts and spinose tips. The dorsal cirrus behind has an enlarged base and gently tapered tip. After an interval the slightly convex and long inferior division occurs, with a prominent blunt lobe or papilla rather below its middle posteriorly, and directed inward and backward. A dense series of the strong and slightly brownish, curved (club-shaped) bristles occupies the whole length of the division, with a few tapering serrated forms amongst them. Most of the short, strong forms show distinct serrations towards the curve. The ventral division ends in a notch ventrally.

After the change in the structure of the foot occurs, as at the twenty-third, the slightly tapered dorsal cirrus has in front of it a group of long tapering bristles with smooth shafts and serrated tips, and a few bifid forms—all supported by four spines. A low rounded papilla closely adjoining the foregoing represents the inferior division with two spines and a few slender serrated bristles. Posteriorly a ventral cirrus appears beneath the division.

[1] 'Bullet. Scientif. de la France et de Belgique,' Tom. xxxi, 4e sér., ii, 1898, p. 143.

Synonyms.

1780. *Nais quadricuspida*, Fabricius. Fauna Grœnl., p. 315, n. 296.
1828. *Nainereis* ,, De Blainville. Dict. Sc. Nat., lvii, p. 491.
1843. *Scoloplos* ,, Œrsted. Grönl. Annul. Dorsibr., p. 200, f. 106—110.
1849. *Aricia* ,, Leuckart. Arch. f. Naturges., xv, p. 198, Tab. iii, f. 11.
1851. ,, *quadricuspis*, Grube. Fam. Annel., pp. 68 and 135.
1853. ,, ,, Stimpson. Synops. Mar. Invert. Gr. Manan, p. 33.
1863. *Scoloplos quadricuspis*, idem. Ann. Grœnl. in Proc. Acad. Nat. Sc. Philad., p. 140.
1865. ,, *quadricuspida*, De Quatrefages. Annel., ii, p. 287.
1867. *Naidonereis* ,, Malmgren. Annul. Polych., p. 73.
1869. ,, ,, McIntosh. Rep. Brit. Assoc. (1868), p. 338.
1875. ,, ,, Ehlers. Zeitschr. f. wiss. Zool., Bd. xxv, p. 59, Taf. iv, f. 28.
1878. ,, ,, McIntosh. Trans. Linn. Soc., 2 ser., Zool. i, p. 504.
1897. *Aricia* ,, Birula. Zool. Mus. Kaiser. Akad. Wiss. St. Petersb., p. 20.
1901. ,, ,, Whiteaves. Geol. Surv. Canada, No. 722, p. 79.
1905. *Naidonereis* ,, McIntosh. Ann. Nat. Hist., ser. 7, vol. xv, p. 48.

Habitat.—Procured in numbers between tide-marks, Lochmaddy, August, 1865, generally under stones amidst sandy mud; a young example under *Lithothamnion* between tide-marks, Lerwick, Shetland.

Greenland (O. Fabricius).

Head (Plate LXV, figs. 5 and 5 *a*) forming a rounded and somewhat button-shaped process set on the peristomial segment, which forms a short cone and is two-ringed (being notched on each side).

Body about 3 ins. in length, tapering very slightly in front, but considerably diminishing towards the tail, which ends somewhat abruptly in two rounded dorsal papillæ, and two short ventral cirri.

The anterior region consists of thirteen segments with the specially modified ventral division of the feet. The branchiæ in the sole example commenced on the sixth foot, but it may be that those on the dorsum of the body at the fifth foot had been lost. They remain of comparatively large size to within eight or ten segments from the tip of the tail. When fully formed, as at the tenth foot (Plate LXXXVII, fig. 5), the branchia is a flattened and somewhat acutely lanceolate process. A convex border of some extent intervenes between it and the slight elevation of the dorsal division of the foot bearing a fan-like tuft of tapering bristles (Plate LXXXVI, fig. 2), which have smooth shafts but spinose tips (with a marked bend) simulating cameration. The dorsal cirrus behind has a somewhat enlarged base and gently tapered tip (which is not acute). A smooth margin intervenes between this division and the slightly convex and long inferior division, which has a prominent blunt lobe or papilla rather below its middle posteriorly, directed downward and backward. A dense series of the strong and slightly brownish curved (club-shaped) bristles (Plate LXXXVI, fig. 2 *a*) occupies the whole length of the division, with here and there a long serrato-camerated tapering bristle or two projecting beyond them. Most of these short and strong bristles show distinct serrations towards the curve, as if they were developed from broken forms. The tips of many are rounded,

but others are cracked. It may be that enlargement of these occurs after fracture, though some of similar form in a developing condition have been seen in the tissues. The prominent ridge of the foot ends in a notch ventrally, and the surface trends to the mid-ventral line.

A change occurs at the fourteenth foot, and is well marked at the twenty-third (Plate LXXXVII, fig. 5 *a*), the slightly tapered dorsal cirrus having in front of it a group of long tapering bristles with smooth shafts and serrated tips (Plate LXXXVI, figs. 2 *b* and 2 *b'*). These are supported by about four spines. Moreover bifid bristles appear in the dorsal division about the twentieth foot, and continue to the posterior region. The shafts in the twentieth foot are rather strong, cylindrical, and translucent, and further show, by the play of light, indications of serrations, though none are actually present. The limits of the fork are "finished" distally and slightly enlarged, and the inner edges are spinous. A low rounded papilla closely adjoining the foregoing represents the inferior division of the foot and has two spines which pierce the tip, and a few slender serrated bristles. The edge below is boldly convex.

The chief changes in connection with the posterior feet are (1) the diminution in the convexity of the body-wall below the foot, (2) the diminution in the size of the dorsal cirrus, (3) the increase in the size of the ventral division of the foot, and (4) the appearance of a ventral cirrus beneath it (Plate LXXXVII, fig. 5 *b*) a little in front of the tail. The bifid bristles of the dorsal division are continued posteriorly, and they have stout shafts, the sides of which present serrations, the bifid tip being short but stout, the inner edges being spinous, and the terminal spine on each side projecting beyond the truncated ends of the bifid region.

Œrsted (1843) added little to the account of O. Fabricius, but he gave recognizable figures and grouped the form under the Ariciæ, a family of his Chætopoda Terricolina.

Grube (1851) included *Nainereis* in his last family of the tribe Rapacia of the Appendiculate Polychæta.

A young form found in *Lithothamnion* between tide-marks, Shetland, July, 1871, belongs to this species. The snout is bluntly rounded, and is followed by two double-ringed segments. The bristled segments are forty-two or forty-three, and the caudal cirri are comparatively large. It is about 6 mm. in length.

The original account of O. Fabricius (1780) is fairly complete, without touching on the microscopic characters of the bristles, and shows how acutely this zoologist had observed Nature. Even the habits and food of this species did not escape him.

It is probable that the *Scoloplos minor* of Œrsted[1] is this species. The author describes the head as globose, and the tail is furnished with four filiform appendages.

The head of Théel's *Aricia Tullbergi*, from Nova Zembla, agrees in outline with this form, but in other respects it differs, notably in the absence of dorsal bristles, yet the latter may have been accidental, for such is a very exceptional condition in the group.

2. Nainereis mammillata, *Claparède.*

Cunningham and Ramage found an example which they referred to the above species

[1] 'Kroyer's Nat. Tids.,' 1842—3, p. 125.

in Laminarian roots at the Birnie Rocks near Granton Quarry. They describe it[1] as having an obtuse rounded head, and a pair of eyes; branchiæ commencing on the fifth segment; feet with a dorsal division of a single cylindrical process with a fascicle of long capillary bristles in front, a ventral division consisting of a mammiform projection with a nipple-like process at the end, on the anterior surface exteriorly a row of capillary setæ, proximally a large number of short thick setæ, bifid at the apex (the latter being present only in the first ten to fifteen segments). Amongst the dorsal bristles in the middle of the body are some two-pronged.

As the preparations made by the authors have disappeared, it is not possible to re-investigate the subject at present. The form, described as *Theodisca Mamillata*, appears to be a *Nainereis*.

Nainereis, sp. 1. Plate LXXXV, figs. 10 and 10 *a*—bristles.

A form which appears to be related to the above genus has more than once occurred at St. Andrews, but the condition of the examples is such that no complete account can at present be given, and since the bristles were drawn the preparation has been mislaid.

Habitat.—Tossed on shore at the West Sands after storms both in summer and spring. It would appear, therefore, to reside in the sandy ground in the bay.

Head somewhat flattened, bluntly conical. *Body* of considerable size, probably 6 to 8 ins. long, somewhat flattened dorsally and ventrally, rounded at the sides. It is slightly narrowed anteriorly and more distinctly tapered posteriorly, where it terminates in four short cirri. A median ridge occurs at the ventral surface. Claparède's form had longest dorsal cirri at vent. A folded proboscis seems to have issued from the anterior end, but it is injured. The segments are both narrow and numerous. Dorsally each segment anteriorly has a long narrow bar with pointed ends, and behind it a ridge connecting the dorsal papillæ of opposite feet. Ventrally each segment has three transverse furrows or creases.

Nainereis, sp. 2. Plate LXXXV, figs. 10 and 10 *a*—bristles; Plate LXXXVI, fig. 19—bristle.

Specific Characters.—Head somewhat flattened, bluntly conical (from above). Eyes unknown. Body rather large, flattened, slightly narrowed anteriorly. Ventral surface with a median ridge. Segments narrow; dorsally each has a narrow bar with pointed ends in front, and behind it is a ridge connecting the dorsal papillæ of opposite feet. Ventrally each segment has three transverse furrows. Tenth foot has a prominent dorsal papilla for the bristles, which are simple, golden, stout, and slightly curved. After an interval a long elevated ridge represents the inferior division, and by-and-by this forms a flap sloping backward, the dorsal papilla fusing with it superiorly. Ventral bristles have a sharp hook at one side of the blunt tip, with a wing. At the ventral edge are long, simple bristles with finely tapered tips.

[1] 'Trans. Roy. Soc. Edin.,' vol. xxxiii, pp. 642—643, 1888.

The feet are very small in front, but they conform to the type behind. About the tenth foot is a somewhat prominent dorsal papilla for the bristles, which are simple, golden, stout, and slightly curved. They have longitudinal striæ and also a few transverse ones (Plate LXXXVI, fig. 19). The tip seems to be slightly hooked and to have a wing in some. The difficulty is their absence, as few feet show any. After an interval a long elevated ridge represents the inferior division, and by-and-by this forms a flap sloping backward, the dorsal papilla fusing with it superiorly, so that both are included in the free flap. The ventral bristles have a sharp hook at one side of the blunt tip, with a wing. At the ventral edge are long simple bristles with finely tapered tips, to which mucus adheres.

Both dorsal and ventral bristles seem to be extremely brittle.

This form, whilst agreeing in certain respects with *Nainereis*, leans also to the Spionidæ. It was tossed on the West Sands, St. Andrews, after a storm.

INDEX TO VOL. II.

	PAGE
Alciopidæ	112
Amblyosyllis	224
lineata	225
Anaitis	70
Jeffreysii	73
Kosteriensis	72
rosea	71
Arabella	394
iricolor	395
Aricia	497
Armandi	508
Cuvieri	497
Edwardsi an. var. Cuvieri	501
Grubei	505
Latreillii	502
norvegica	506
Ariciidæ	494
Autolytea	209
Autolytus	209
aurantiaca	214
ehbiensis	243
? female bud	223
inermis	247
longiferiens	245
pictus	211
prolifer	215
Castalia	120
arctica	125
fusca	127
punctata	121
Dalhousiella	134
Carpenteri	134
Drilonereis	392
longa	393
Eteone	98
arctica	102
var. Robertiana	103
Eteone picta	100
pusilla	106
spetzbergensis	104
Eulalia	50
bilineata	50
imbricata	64
macroceros	60
nebulosa	53
tripunctata	63
viridis	55
Eumida	66
sanguinea	66
Eunice	425
fasciata	425
floridana	439
norvegica	434
vittata	431
Eunicidæ	343
Eurysyllis	241
paradoxa	241
Eusyllidea	160
Eusyllis	173
Blomstrandi	176
tubifex	173
Exogone	149
gemmifera	151
var. Scharffi	154
naidina	150
Exogonea	149
Genetyllis	94
citrina	96
hibernica	97
lutea	95
Glycera	477
alba	486
Ehlersi	481
Goësi	491
lapidum	477
siphonostoma	482

	PAGE
Glyceridæ	471
Glycinde	469
Nordmanni	469
Goniada	462
eremita	466
maculata	462
Goniadidæ	460
Grubea	234
clavata	235
Hesionidæ	114
Hyalinœcia	417
sicula	417
tubicola	419
Leocrates	130
atlantica	130
Leptonereis	263
Vaillanti	264
Lumbriconereis	371
acutifrons	388
fragilis	372
G.—fragment	387
gracilis	385
hibernica	383
impatiens	379
Latreillii	376
(Zygolobus) laurentianus	390
Lysidice	456
punctata	456
Magalia	136
perarmata	136
Marphysa	442
Belli	448
Kinbergi	451
sanguinea	442
Micronereis	260
variegata	261
Microsyllis	159
Marenzelleri	160
Myrianida	228
pinnigera	229
Mysta	108
barbata	108
Mystides	109
Lizziæ	110
Nainereis	516
mammillata	519
quadricuspida	517
sp. 1	520
sp. 2	520
Nematonereis	453
sp.	456
unicornis	453
Nephythydidæ	1
Nephthys	6
cæca	8
ciliata	23
cirrosa	36
Grubei	33
Hombergii	17
hystricis	27
incisa	38
Johnstoni	34
longisetosa	29
pansa	40
Nereicola ovata	286
Nereidæ	249
Nereis	267
cultrifera	280
diversicolor	312
Dumerilii	302
fucata	336
longissima	325
Marionii	295
pelagica	267
Schmardæi	291
virens	330
Nerilla	147
antennata	147
Notocirrus	400
scoticus	400
sp.?	403
Notophyllum	46
foliosum	46
Odontosyllis	178
ctenostoma	182
fulgurans	178
gibba	183
Onuphididæ	403
Onuphis	404
brevibrachiata	407
britannica	404

	PAGE
Onuphis conchylega	410
fragosa	415
quadricuspis	413
Ophiodromus	116
flexuosus	117
Ophryotrocha	364
puerilis	364
Phyllodoce	74
grœnlandica	86
lamelligera	76
maculata	89
Paretti	82
rubiginosa	92
vittata	93
Phyllodocidæ	41
Pionosyllis	161
alternosetosa	238
divaricata	164
hyalina	166
lamelligera	236
prolifera	161
Scoloplos	509
armiger	510
Sphærosyllis	156
hystrix	156
Staurocephalidæ	350
Staurocephalus	352
B	362
ciliatus var. Robertianæ	359
Staurocephalus Kefersteini	358
pallidus	363
rubrovittatus	353
Syllidæ	137, 233
Syllidea (proper)	187
Sylline	186
rubropunctata	186
Syllis	188
abyssicola	207
armillaris	188
brevicirrata	196
brevicollis	208
Buskii	206
cornuta	200
var. Collingsii	202
cucullata	191
Cunninghami	195
gracilis	203
Krohnii	192
macroceras	194
spongicola	197
Trypanosyllis	169
cæliaca	240
zebra	169
Xenosyllis	155
Kinbergi	155
Zygolobus (Lumbriconereis)	390
laurentianus	390

ADLARD AND SON, IMPR., LONDON AND DORKING.

PLATE LI.

Fig.

1. *Trypanosyllis zebra*, Grube, from Plymouth. Enlarged.
2. *Pionosyllis* (*Typosyllis*) *hyalina*, Grube, from Plymouth. Enlarged.
3. *Syllis gracilis*, Grube, from Plymouth. Enlarged.
4. *Syllis spongicola*, Grube, from Plymouth. Enlarged.
5. Head of *Odontosyllis fulgurans*, Aud. and Edw.
6. *Onuphis britannica*, McI., from Plymouth, removed from its tube and seen from the dorsal surface. Enlarged.

6 *a*. Head and anterior region of the foregoing, still further enlarged.

1

2

6

3

4

5

6a

A.H.Wilde.

Werner & Winter, Frankfurt a/M.

PLATE LII.

Fig.

1. *Nereis pelagica*, L. Adult female (atokous) of a russet-brown hue in September, St. Andrews. Enlarged.
2. An epitokous male on 17th February, St. Andrews. The tail is in process of reproduction. Enlarged.
3. *Nereis cultrifera*, Grube, from East rocks, St. Andrews, in the atokous condition. The tail is developing.
4. *Nereis diversicolor*, O. F. Müller, from St. Andrews. Enlarged.

4 *a*. Example with the proboscis extruded, from St. Andrews. Slightly enlarged.

5. *Nereis Dumerilii*, Aud. and Edw., from a sketch at Lochmaddy. Slightly enlarged.
6. *Nereilepas fucata*, Sav., from the Moray Firth. In a shell of *Buccinum undatum* with a hermit-crab.
7. *Nereis Schmardæi*, De Quatref., from the dorsum. Enlarged.

7*a*. Tail of the same. Still more enlarged.

1

2

7

5

7ª

6

3

4ª

4

Fig 4. B.M. del. et lith. Fig 5 W.C.M. Oakeley R.A. P.V.

Weimar's Kunst-Anstalt Frankfurt a/M.

PLATE LIII.

Fig.

1. *Nereis virens*, Sars, from an example tossed on shore on the West Sands, St. Andrews, and carried alive to Murthly, where it was drawn. Natural size.

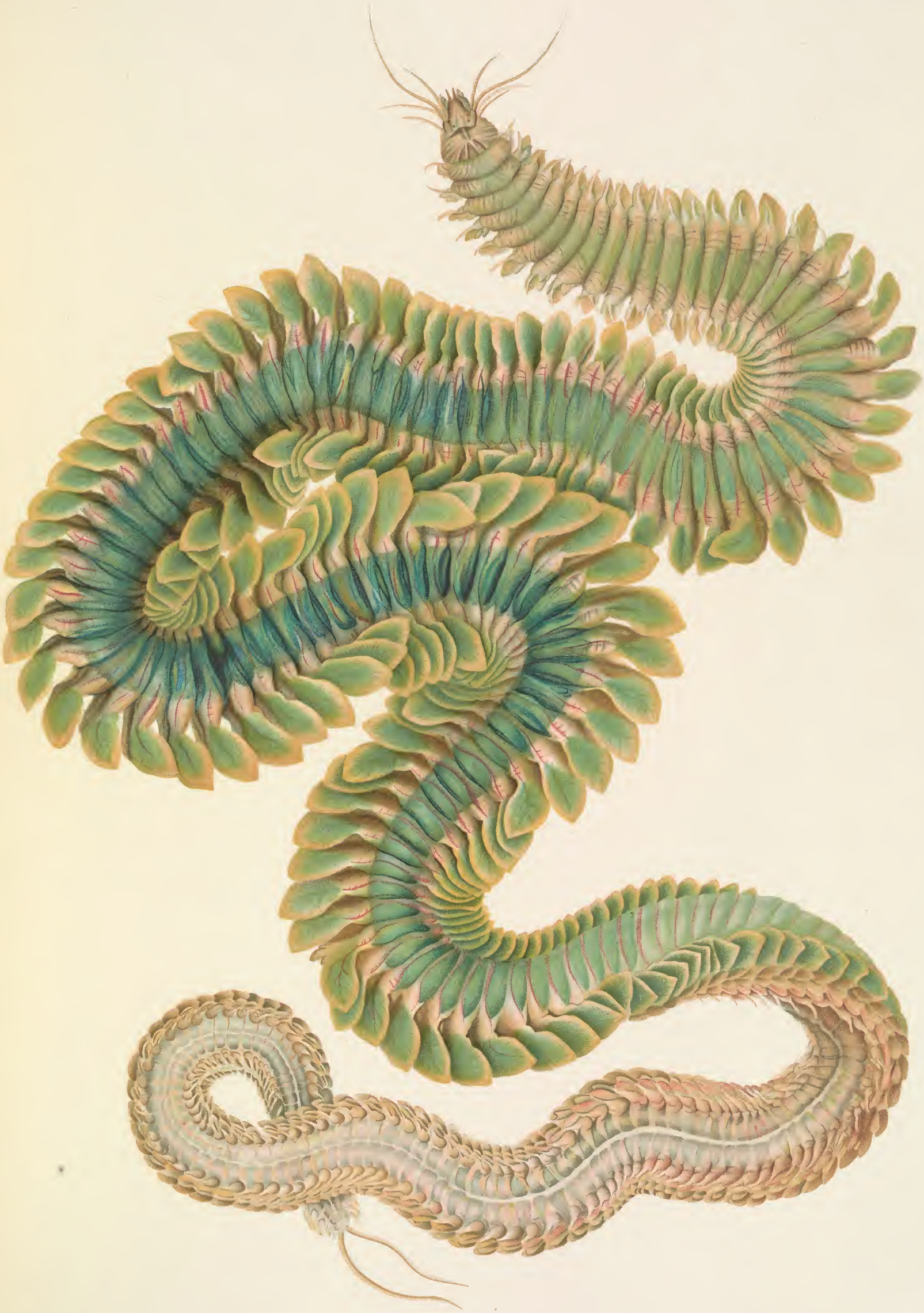


PLATE LIV.

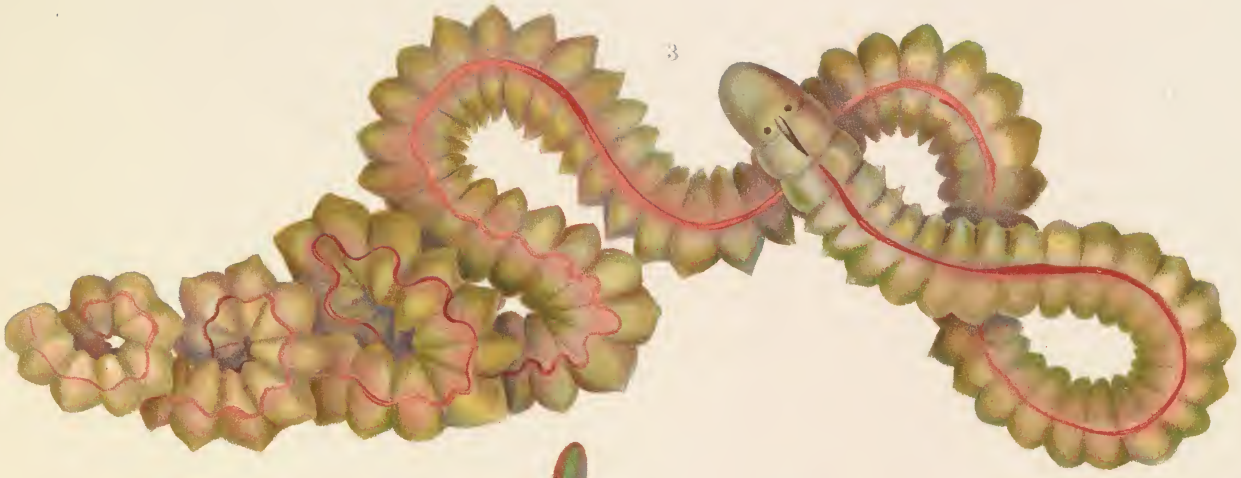
Fig.

1. *Eunice fasciata*, Risso, from St. Peter Port, Guernsey. Enlarged.
2. *Marphysa sanguinea*, Mont., from St. Peter Port, Guernsey. The branchiæ in this figure are less characteristic than usual. Their structure is seen in Plate LXXIV, fig. 8. Enlarged.
3. *Nematonereis unicornis*, Grube, from St. Peter Port, Guernsey. Enlarged.
4. *Arabella iricolor*, Mont., from St. Peter Port, Guernsey. Enlarged.
5. *Hyalinœcia tubicola*, O. F. Müller, from Plymouth, removed from its tube and viewed from the dorsum. Enlarged.

5 *a*. Head and anterior region of the foregoing. Enlarged.

5 *b*. Caudal region of the same. Enlarged.

6. *Lumbriconereis Latreillii*, Aud. and Edw. Enlarged.


3

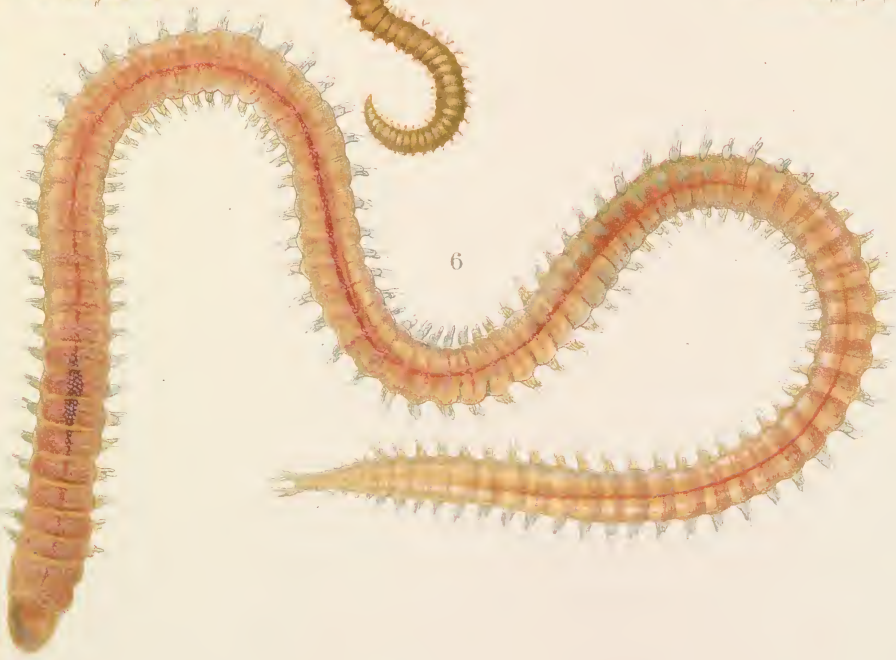
2

4

1

5

5b


6

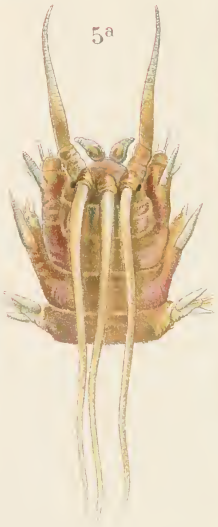
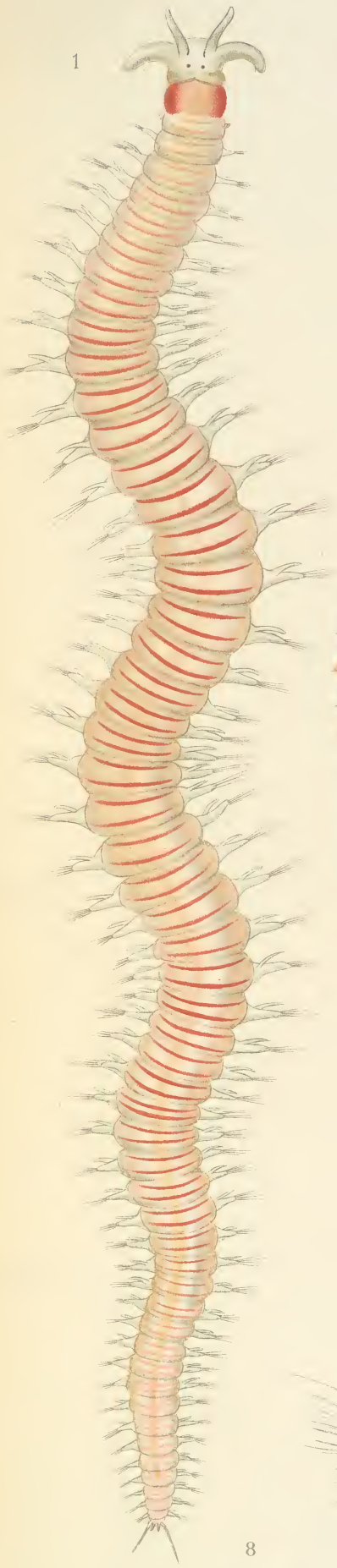

5a

PLATE LV.

Fig.

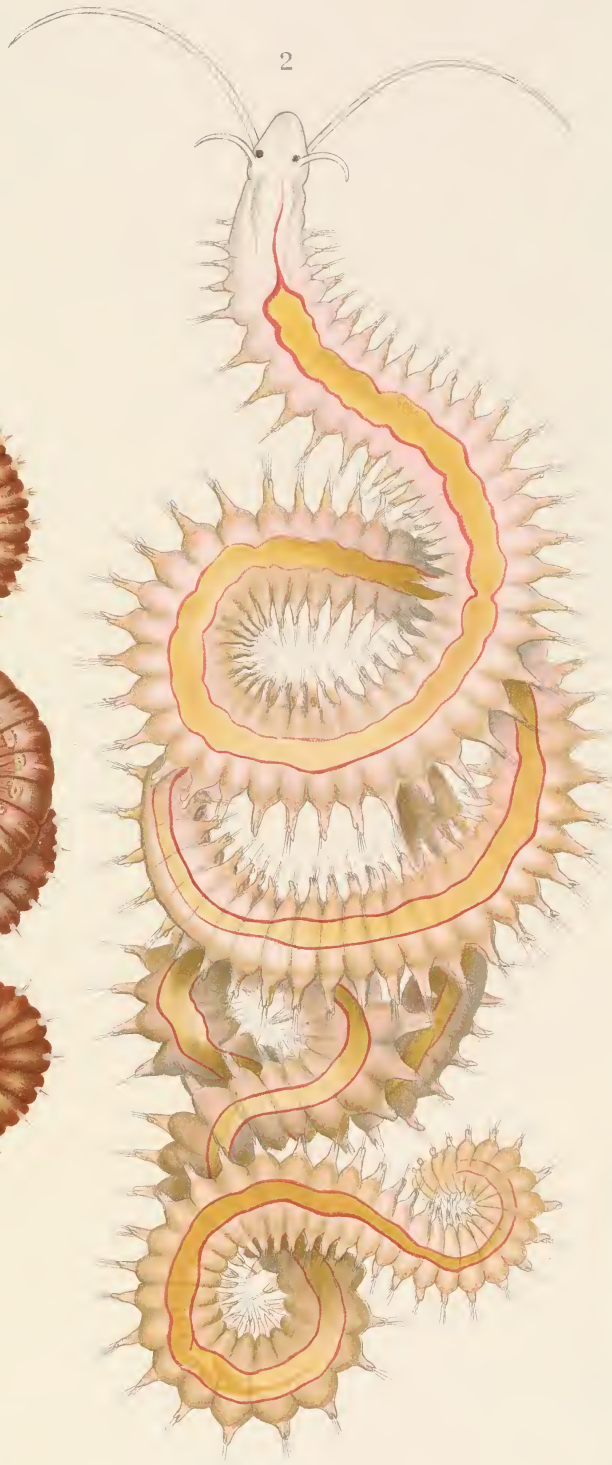
1. *Staurocephalus rubrovittatus*, Grube, from Herm. Enlarged.
2. *Staurocephalus Kefersteini*, McI., from North Uist and Channel Islands. Enlarged.
3. *Lysidice punctata*, Risso, from Jersey. Enlarged.
4. *Glycera lapidum*, De Quatref., from St. Andrews. Enlarged.
5. *Marphysa Belli*, Aud. and Edw., from Plymouth. Enlarged.
6. Eighth foot of the foregoing. × 25.
7. Head and anterior region of *Nematonereis*, from Plymouth. Enlarged.
8. Tip of the tail of the same. Enlarged.
9. Head and anterior region of *Ophryotrocha puerilis*, Clap. and Meczn., from Plymouth. Enlarged.

1



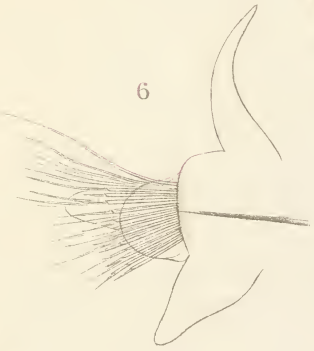
3

2

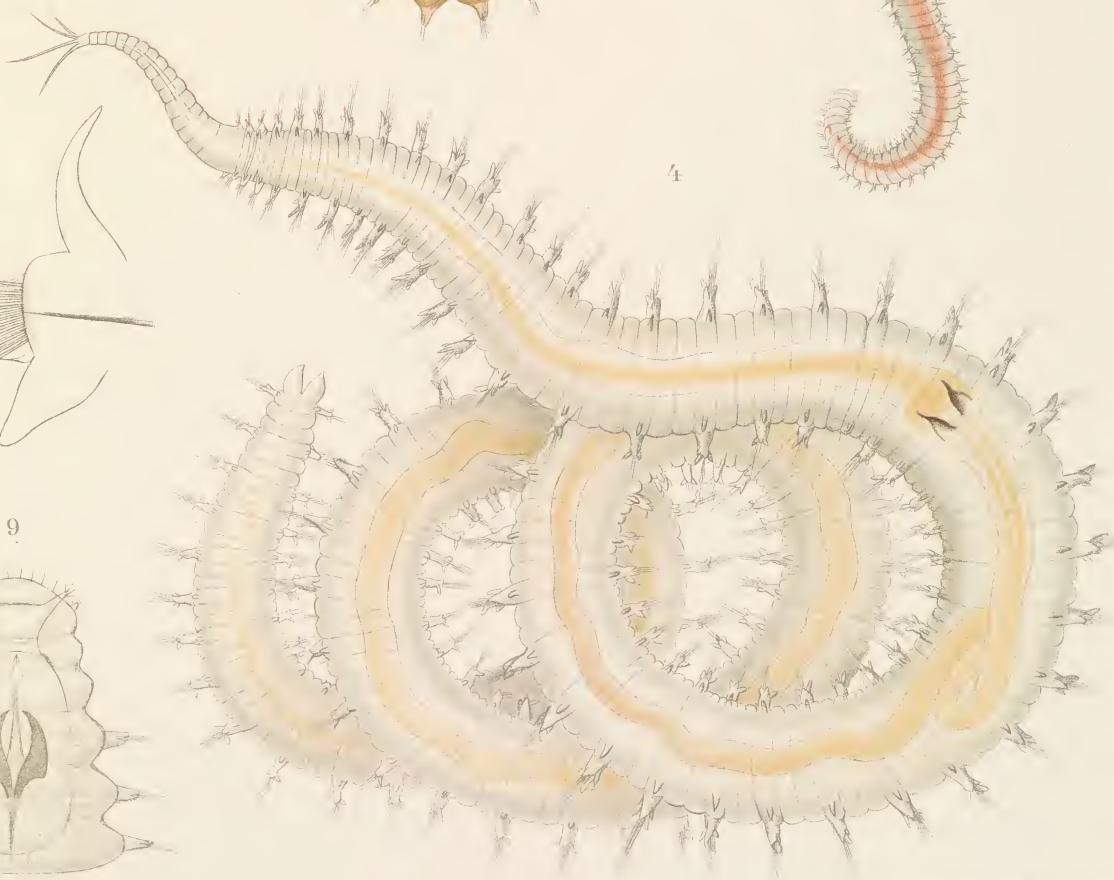


5

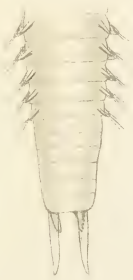
6



4

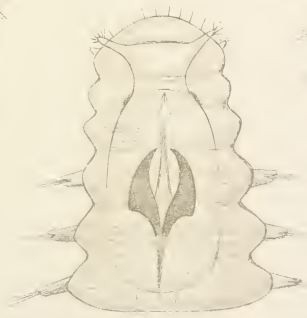


8



7

9



R.N. Figs. 1 to 4. Cœtera A.H.W.

PLATE LVI.

Fig.

1. *Aricia Latreillii*, Aud. and Edw., from St. Andrews. Enlarged.
1 *a*. View of tip of tail with vent and cirri. Enlarged.
2. *Goniada maculata*, Œrsted, from the sand, near low water-mark, St. Andrews. Enlarged.
3. Mid-dorsal segments of the same. Enlarged.
4. *Ophryotrocha puerilis*, Clap. and Meczn. Enlarged.
5. Tip of tail of the foregoing. Enlarged.
6. *Nematonereis* from Plymouth, 7th September, 1905, from the dorsum. Enlarged.
7. *Scoloplos armiger*, O. F. Müller. Dorsum shown anteriorly; posterior region seen laterally.

1

1a

3

5

7

4

6

2

PLATE LXXI.

Fig.

1. Foot of *Amblyosyllis lineata*, A. Costa. The process above the setigerous region is often more pointed, and the cirrus has its basal region directed dorsally. × 55.
2. Foot of *Autolytus pictus*, Ehlers. × about 55.
3. Foot of *Autolytus aurantiacus*, Claparède, viewed obliquely from above. × about 55.
4. Foot of female bud of *Autolytus prolifer*, O. F. Müller. × about 55.
5. Foot of nurse-stock of *Myrianida pinnigera*, Mont. × about 55.
6. Foot of female bud of the same with developing swimming bristles. × about 55.
7. First foot of *Nereis pelagica*, L. × 15.

7 *a*. Tenth right foot of the same. × 15.

7 *b*. Thirty-seventh right foot of the foregoing. × 15.

7 *c*. Fifty-seventh foot (right). × 15.

7 *d*. First foot of a large epitokous male from the West Sands, St. Andrews. × about 12.

7 *f*. Thirty-seventh foot of epitokous form. × 12.

7 *g*. Fifty-seventh foot of the foregoing. × 12.

7 *h*. Eightieth foot of the same. × 12.

7 *i*. Twenty-eighth foot of a young example of *Nereis pelagica* from St. Andrews with clavate parasitic growth. Viewed from the dorsum. × 90.

8. First foot of *Nereis cultrifera*, Grube. × 15.

8 *a*. Tenth foot of the same. × 15.

8 *b*. Thirty-seventh foot of this species. × 15.

8 *c*. Fifth foot from tip of tail. × 15.

8 *d*. Nineteenth foot of epitokous male. × 15.

1.

2.

3.

4.

5.

6.

7 a

7 b

7 c

7 d

7 e

7 f

7 g

7 h

8.

8 a

8 b

8 c

8 d

A.H.W.& W.C.M. del.

Vincent Brooks Day & Son Lith.

PLATE LXXII.

Fig.

1. Twentieth foot of the epitokous male *Nereis cultrifera*, Grube. × 15.
1 *a*. Thirty-seventh foot of the foregoing. × 12.
1 *b*. Fifty-seventh foot of the same male. × 10.
1 *c*. Foot of this form near tip of tail. × 15.
2. First foot of *Nereis Schmardæi*, De Quatref. (*irorata*, Malmgren). × 15.
2 *a*. Tenth left foot of the same, from the front. × 15.
2 *b*. Sixty-fifth foot of a ripe epitokous female from St. Vaast (Prof. Grube's). × 15.
3. First foot of *Nereis Marioni*, Aud. and Edw. × about 14.
3 *a*. Tenth foot of the same. × 15.
3 *b*. Thirty-seventh foot. × 15.
3 *c*. Fifty-seventh foot. × 15.
3 *d*. Sixty-eighth foot. × 15.
4. First foot of *Nereis Dumerilii*, Aud. and Edw. × 15.
4 *a*. Tenth foot. × about 15.
4 *b*. Thirty-seventh foot. × 21.
4 *c*. Fifty-seventh foot. × 13.
4 *d*. First foot of epitokous form (male) of the same species from the surface in Castle Bay, Barra, in May. × 21.
4 *e*. Sixth left foot of an epitokous male. × 21.
4 *f*. Thirty-seventh foot of the same male. × 18.
5. First foot of *Nereis diversicolor*, O. F. Müller, from St. Andrews. × about 21.
5 *a*. Tenth foot of the same from Herm. × 15.
5 *b*. Thirty-seventh foot. × 15.

1.

1 a.

3 b.

4.

4 b.

2.

1 b.

4 c.

4 a.

2 b.

1 c.

2 a.

3 c.

5 b.

4 f.

3 e.

4 d.

3.

5 a.

5.

4 e.

3 d.

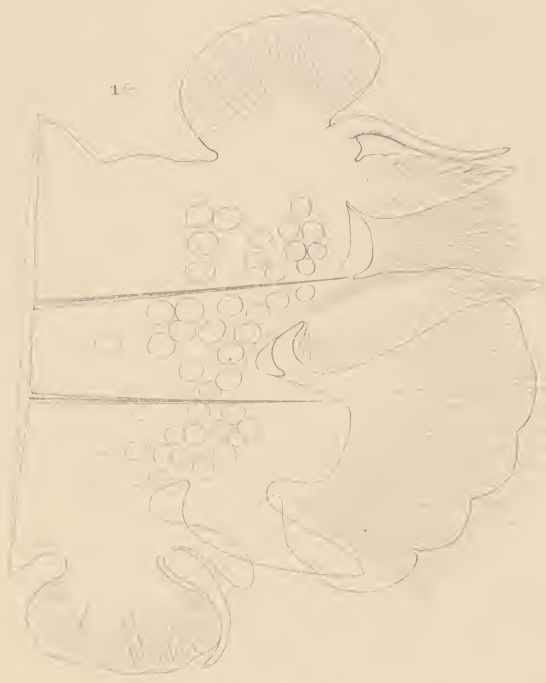
PLATE LXXIII.

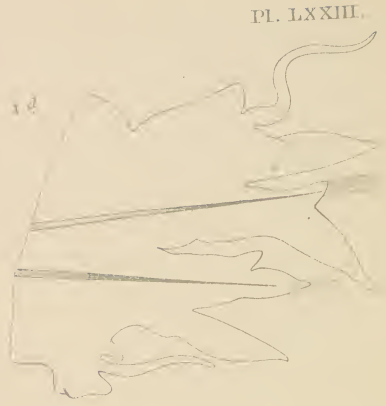
Fig.

1. First foot of *Eunereis longissima*, Johnst. × 15.
1 *a*. Tenth foot. × 15.
1 *b*. Sixty-sixth foot of an example (var.) from the Bay of Tunis. Enlarged.
1 *c*. Sixty-seventh foot of an epitokous female. × 18.
1 *d*. Foot of the foregoing near the tip of the tail. × 15.
2. First foot of *Alitta virens*, Sars. × 13.
2 *a*. Tenth foot (right). × 12.
2 *b*. Thirty-seventh foot. × about 12.
3. First foot of *Nereilepas fucata*, Sav. × about 15.
3 *a*. Tenth foot. × about 15.
3 *b*. Twenty-seventh foot of epitokous female. × 12.
3 *c*. Fifty-seventh foot of the foregoing. × 12.
4. Foot of *Staurocephalus rubrovittatus*, Grube, from the middle of the body. × 60.
4 *a*. Foot of a young pelagic form of the same, caught in tow-net off Sark by Mrs. Collings. × 60.
5. Typical foot of *Staurocephalus Kefersteini*, McI. × Zeiss oc. 2, obj. D.
6. Twentieth foot of *Staurocephalus ciliatus*, Kef., var *Robertianæ*, from St. Peter Port, Guernsey. × 65.
7. Foot of *Ophryotrocha puerilis*, Clap. and Mecz. × 100.
8. First foot of *Lumbriconereis fragilis*, O. F. Müll. × 25.
8 *a*. Tenth foot of variety of the foregoing. × 25.
8 *b*. Fiftieth foot from a specimen dredged off Sark by Col. Fraser and Capt. Powell. × 25.
8 *c*. Foot (sixtieth) from the posterior region. × 25.
9. Tenth foot of *Lumbriconereis Latreillii*, Aud. and Edw., from Bantry Bay. × 55.
9 *a*. Foot (about fifteenth) of the same. × 55.
10. Tenth foot ? of *Lumbriconereis impatiens*, Clap., from Plymouth. The long hooks have been omitted. × 55.
10 *a*. One hundredth foot of the foregoing form. The long hooks have been omitted. × 55.
10 *b*. Fifty-seventh foot of a specimen from the 'Knight Errant.' × 55.

1.

1 a


1 c


1 d

9 a

1 b

2

2 b

5

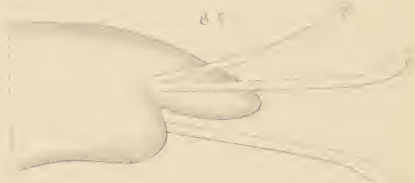
2 a

4 a

3.

3 a

4.

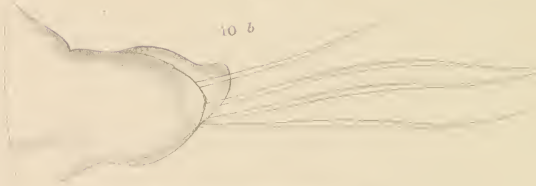

8 f

6.

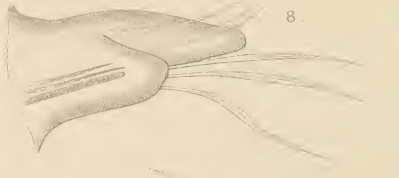
10

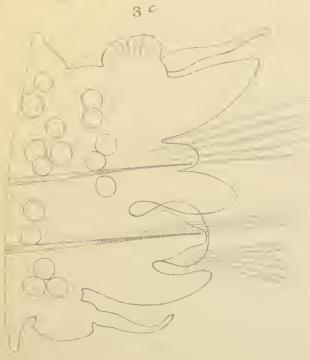
3 b

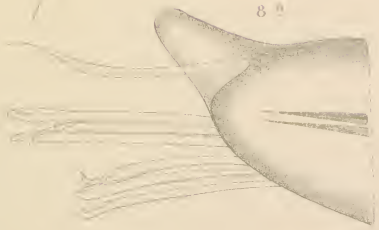
11

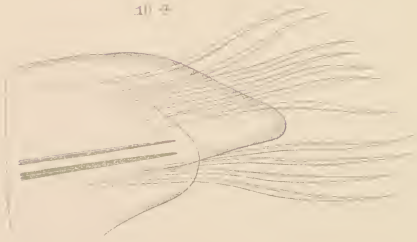

10 b

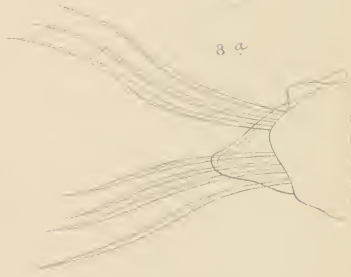
7.


8.


3 c


8 b


10 a


8 a

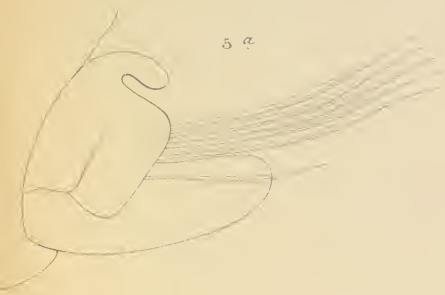
W. & A. K. Johnston del.

f.a P.W.M.Trap impr.

PLATE LXXIV.

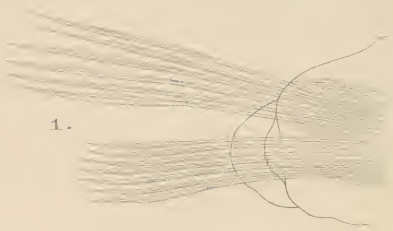
Fig.

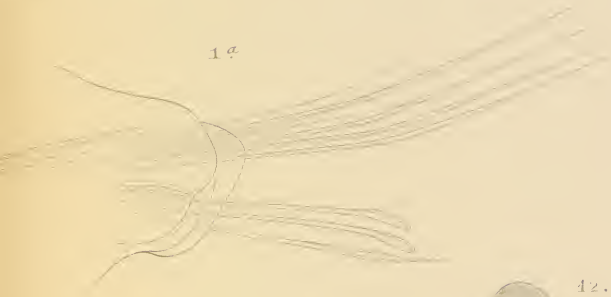
1. Tenth foot of *Lumbriconereis hibernica*, McI. × about 60.
1 *a*. Thirtieth foot of the foregoing. × about 60.
2. Foot of *Lumbriconereis G*. × Zeiss oc. 2, obj. A, full draw-tube.
3. Foot of *Lumbriconereis* (*Zygolobus*) *laurentianus*, Grube (from a somewhat softened preparation from the stomach of cod, St. Andrews); middle third of the body. × 35.
4. Sixth foot of *Drilonereis Elisabethæ*, McI., turned round so as to show the dorsal process. × about 35.
5. First foot of *Arabella iricolor*, Mont., from St. Peter Port, Guernsey. × 50.
5 *a*. Tenth foot. × 50.
5 *b*. Foot from the middle of the body. × 50.
5 *c*. Foot from the posterior region. × 50.
6. Typical foot of *Notocirrus scoticus*, McI., from Lochmaddy; *a*, branchial lobule (cirrus); *b*, spine; *c*, bristles. × 350.
6 *a*. Foot showing two papillæ from example procured off Peel, Isle of Man. × 50.
7. Tenth foot of *Eunice fasciata*, Risso. × 35.
7 *a*. Ninetieth foot. × 21.
7 *b*. Foot near tip of tail. × 35.
8. Twenty-seventh foot of *Marphysa sanguinea*, Mont. × about 30.
8 *a*. Tenth foot. × about 35.
9. Tenth foot of *Marphysa Kinbergi*, McI. × about 35.
9 *a*. Thirtieth foot also from the 'Porcupine' example, off Cape Finisterre. × about 35.
10. Tenth foot of *Eunice vittata*, D. Chiaje. × about 55.
10 *a*. Twentieth foot. × about 55.
10 *b*. Fortieth foot, from Guernsey. × about 55.
11. Tenth foot of *Eunice norvegica*, L., from Norway. × 21.
11 *a*. Twentieth foot of the same. × 21.
12. Head and anterior region of *Lumbriconereis Latreillii*, Aud. and Edw. Enlarged.


5 a.

2.

5.


1.


1 a.

4.

5 b.

12.

5 c.

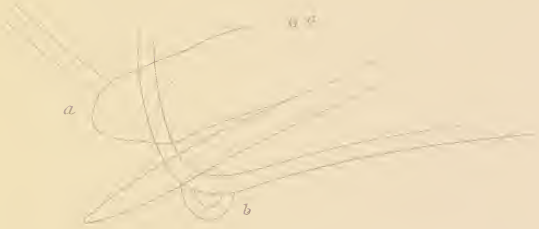
7 a.

3.

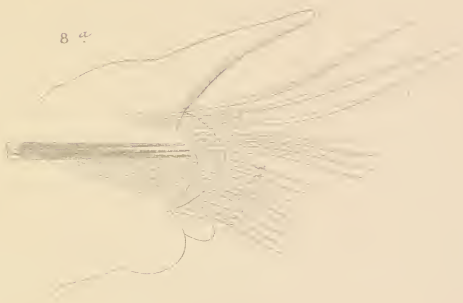
6.

7.

8.

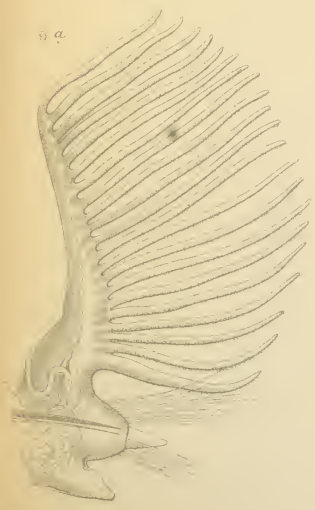

9 a.

7 b.

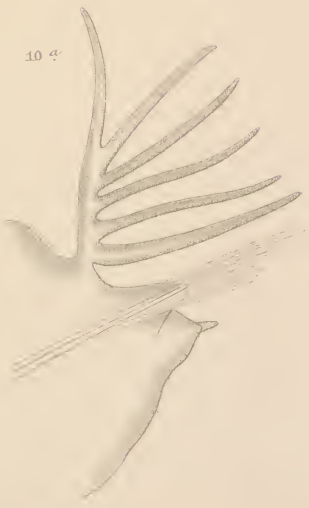

8 a.

9.

11.


9 b.

10.


10 a.

10 b.

11 a.

W.C.M. & A.H.W. del.

f.a P.W.M.Trap impr.

PLATE LXXV.

Fig.

1. Tenth foot of *Eunice norvegica* var. B. A., from the ' Porcupine ' Expedition of 1870. × 21.

1 *a*. About the fortieth foot. × 21.

2. Anterior foot of *Eunice floridana*, Pourt. × 21.

2 *a*. Anterior foot of young example. × 21.

3. Tenth foot of *Nematonereis unicornis*, Grube, from St. Peter Port, Guernsey. × 90.

3 *a*. Twentieth foot. × 90.

4. Tenth foot of *Lysidice punctata*, Risso. × 21.

4 *a*. Thirtieth foot. × 21.

4 *b*. Fiftieth foot. × 21.

5. Twentieth foot of *Onuphis britannica*, McI., from Valentia, ' Porcupine.' × 21.

6. Tenth foot of *Onuphis brevibrachiata*, Ehlers. Enlarged.

6 *a*. Thirtieth foot of the same with an unusual number of branches to branchiæ. Enlarged.

7. Tenth foot of *Onuphis conchylega*, Sars. × 21.

8. Ninth foot of *Onuphis quadricuspis*, Sars, from Cape Rosier, Canada. × 30.

9. First foot of *Onuphis fragosa*, Ehlers. × 55.

9 *a*. Third foot from Bergen. × ?.

9 *b*. Twentieth foot of the same. × ?.

10. Twentieth foot of *Hyalinœcia sicula*, De Quatref. × 21.

11. Tenth foot of *Hyalinœcia tubicola*. × 30.

12. Tenth foot of *Goniada maculata*. × 30.

12 *a*. Fiftieth foot of the same. × 30.

12 *b*. Seventieth foot of *Goniada eremita*, Aud. and Edw., from Cape Finisterre, 'Porcupine,' 1870. × 15.

12 *c*. Posterior foot (hundredth) of the foregoing. × 15.

13. Tenth foot of *Glycinde Nordmanni*, Mgrn. × 50.

13 *a*. Thirtieth foot, from the ' Porcupine,' 1870. × 40.

13 *b*. Sixtieth foot. × 40.

19 *c*. Hundredth foot. × 40.

13 *d*. Unknown foot (seventieth ?). × Zeiss oc. 2, obj. D.

1.

1 a

4 a

4 b

7.

9

2.

3

9 b

13

12 a

11.

10

12.

12 b

6 a

6.

8

13 d

5.

4'

3 a

9 a

13 b

13 c

2 a

12 c

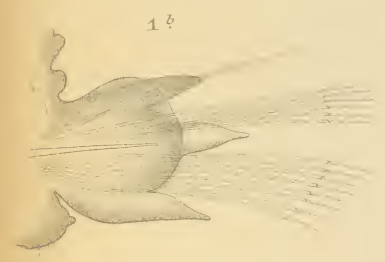
f.a P.W.M. Trey impr.

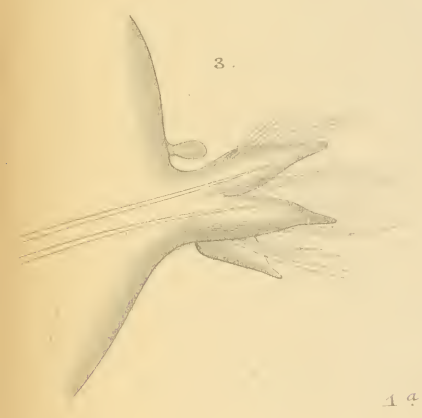
PLATE LXXVI.

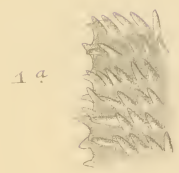
Fig.

1. Tenth foot of *Glycera lapidum*, De Quatref. × 21.
1 *a*. Papillæ of the proboscis. × Zeiss oc. 2, obj. D.
1 *b*. Ninetieth foot of the foregoing.
2. Tenth foot of *Glycera siphonostoma*, D. Chiaje, from Herm. × 21.
2 *a*. Thirtieth foot of a specimen dredged off Cape Guardia, 'Porcupine,' 1870. × 21.
2 *b*. Twentieth foot from the tip of the tail. × 21.
2 *c*. Anterior foot of example from Cape Guardia, 'Porcupine,' 1870. × 21.
3. Tenth foot of *Glycera alba*, H. Rathke. × 21.
3′. Sixteenth foot of example from Donegal Bay, 'Porcupine,' 1869. × 21.
3 *a*. Seventieth foot from a specimen dredged by the 'Porcupine,' 1870, off Cape Sagres. × 21.
3 *b*. Branchia showing crossed fibres. × Zeiss oc. 2, obj. A, with full draw-tube.
3 *c*. Sixtieth foot of an example with longer processes dredged by the 'Porcupine' off Cape Sagres, 1870. × 21.
4. Typical foot (thirty-eighth) of *Glycera Goësi*, Mgrn., from St. Magnus Bay. × Zeiss oc. 2, obj. A, with draw-tube.
4 *a*. Tenth foot. × Zeiss oc. 2, obj. A, with draw-tube.
4′. Thirty-eighth foot. × Zeiss oc. 2, obj. A, with draw-tube.
4 *b*. Seventieth foot. × Zeiss oc. 2, obj. A, with draw-tube.
5. Tenth foot of *Aricia Cuvieri*, Aud. and Edw. × about 21.
5 *a*. The twenty-second foot. × about 21.
5 *b*. Twenty-third foot. × about 21.
5 *c*. Posterior foot. × about 21.

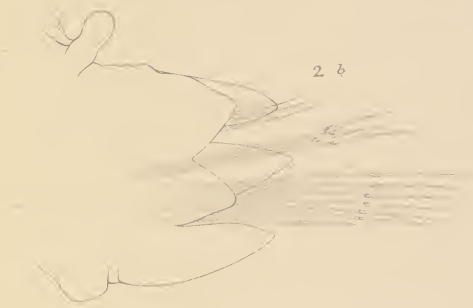
1.

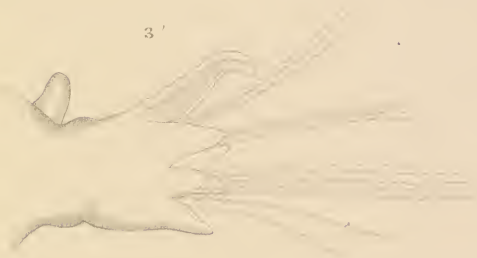

1 b


3.

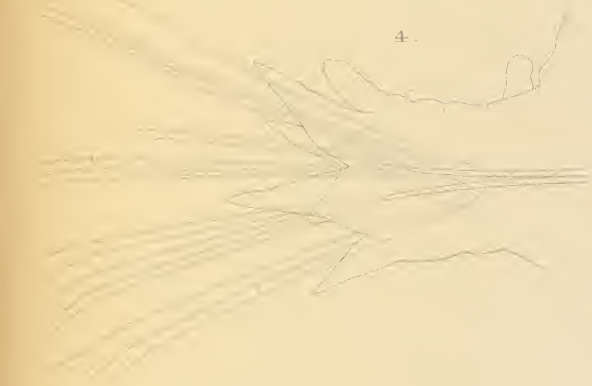

1 a

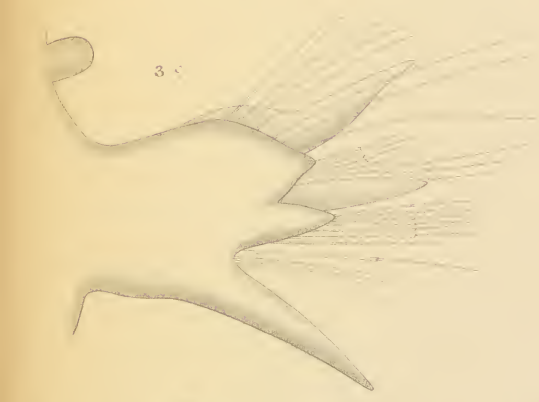
2.


2 b


3'

5.

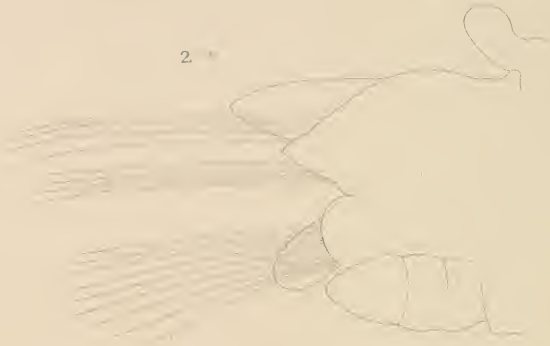

4.


3 c

3 a

4 b

5 c


2 a

2 c

1 c

3 b

4

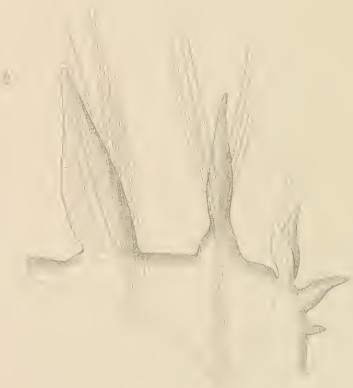

5 b

PLATE LXXVII.

Fig.

1. Upper bristle of *Nephthys cæca*, O. F. Müll. × Zeiss oc. 2, obj. D. 1 *a*, base of the foregoing indicating the arrangement of the spikes on the edge; 1 *b*, barred bristles; 1 *c* and 1 *c'*, the same showing the rows of spikes; 1 *d*, lateral view of a barred bristle; × 250 1 *e*, long capillary bristle from the variety of *Nephthys cæca*.
2. Capillary bristle of *Nephthys Hombergii*, Lamk. × Zeiss oc. 2, obj. D.
3. Barred bristle of the same. × Zeiss oc. 2, obj. D.
4. Capillary bristle of *N. Hombergii*, variety *kersivalensis*, from Lochmaddy. × Zeiss oc. 2, obj. D.
5. Barred bristle from the same. × Zeiss oc. 2, obj. D.
6. Capillary bristles from *Nephthys ciliata*, O. F. Müll. × Zeiss oc. 2, obj. D.

6 *a*. Outline of another bristle showing the curvature. × Zeiss oc. 2, obj. D.

7. Barred bristles from the same. × Zeiss oc. 2, obj. D.
8. Capillary bristle of *Nephthys longisetosa*, Œrst., from St. Magnus Bay, Shetland. × Zeiss oc. 2, obj. D.

8 *a*. Barred bristles of the same. × Zeiss oc. 2, obj. D.

8 *b*. Edge of the capillary bristle showing the spikes. × more highly.

9. Capillary bristles of *Nephthys Grubei*, McI. × Zeiss oc. 2, obj. D.

9 *a*. Barred bristles of the foregoing. × Zeiss oc. 2, obj. D.

10. Capillary bristle of *Nephthys Johnstoni*, Ehlers. This figure, like some others, has been reduced proportionally so as to get it into the plate. × Zeiss oc. 2, obj. D.
11. Barred bristle of the foregoing. × Zeiss oc. 2, obj. D.
12. Capillary bristle of *Nephthys cirrosa*, Ehlers. × Zeiss oc. 2, obj. D.

12 *a*. Outline showing the proportional size of this long bristle which has been reduced as before.

13. Barred bristle of the foregoing. × Zeiss oc. 2, obj. D.
14. Capillary bristle of *Nephthys incisa*, Mgrn. × Zeiss oc. 2, obj. D.
15. Barred bristle of the same. × Zeiss oc. 2, obj. D.
16. Capillary bristle of *Marphysa sanguinea*, Mont. Zeiss oc. 2, obj. D, with draw-tube.

A.H.W. & W.C.M. del.

f.a P.W.M. Trap imp.r.

PLATE LXXVIII.

Fig.

1. Bristle of *Eulalia nebulosa*, Mont. × Zeiss oc. 2, obj. D.
2. Bristle of *Eulalia viridis*, O. F. Müll. × Zeiss oc. 2, obj. D.

2 *a*. Bristle from anterior foot. × Zeiss oc. 4, obj. F.

3. Bristle of *Eulalia macroceros*, Grube. × Zeiss oc. 4, obj. F.
4. Bristle of *Eulalia tripunctata*, McI. × Zeiss oc. 4, obj. F, with 2-in. draw-tube.
5. Bristle of *Eumida sanguinea*, Œrst. × Zeiss oc. 2, obj. D.
6. Bristle of *Phyllodoce lamelligera*, Gmel., from St. Andrews. × Zeiss oc. 2, obj. F.
7. Bristle of *Phyllodoce grœnlandica*, Œrst., from St. Andrews. × Zeiss oc. 2, obj. F.
8. Bristle of *Phyllodoce rubiginosa*, De St. Jos. × Zeiss oc. 2, obj. F.

8 *a*. Another bristle. × Zeiss oc. 2, obj. F.

9. Bristle of *Phyllodoce vittata*, Ehlers, from St. Magnus Bay. × Zeiss oc. 2, obj. F.
10. Bristle of *Anaitis rosea*, McI. × Zeiss oc. 2, obj. F.
11. Bristle of *Anaitis Kosteriensis*, Mgrn. × Zeiss oc. 2, obj. F.
12. Bristle of *Anaitis Jeffreysii*, McI. × Zeiss oc. 2, obj. F.
13. Bristle of *Genetyllis lutea*, Mgrn. × Zeiss oc. 2, obj. F.
14. Bristle of *Genetyllis citrina*, Œrst., from the Minch. × Zeiss oc. 2, obj. F.
15. 15 *a*, and 15 *b*. Bristles of *Genetyllis hibernica*, McI. × Zeiss oc. 2, obj. F.
16. Bristle of *Eteone spetsbergensis*, Mgrn., from St. Andrews. × Zeiss oc. 2, obj. F.

16 *a*. Bristle of the same from Gaspé Bay, Canada. × Zeiss oc. 2, obj. F.

16 *b*. Bristle of the foregoing from Lochmaddy, North Uist. × Zeiss oc. 2, obj. F.

17. Bristle of *Eteone pusilla*, Œrst., from Shetland. × Zeiss oc. 2, obj. D.
18. Bristle of *Eteone arctica*, Mgrn., var. *Robertiana*. × Zeiss oc. 2, obj. D.
19. Bristle of *Mysta barbata*, Mgrn., from the twenty-ninth foot, West Sands, St. Andrews. × Zeiss oc. 4, obj. F.

19 *a*. Bristle of the same from a posterior foot. × Zeiss oc. 4, obj. F.

20. Bristle of *Mystides Lizziæ*, McI. × Zeiss oc. 2, obj. D.
21. Bristles of *Notophyllum foliosum*, Sars. *a*, lateral view, × 420; *b*, end of shaft in profile, × 700; and *c*, the same viewed laterally, × 700.
22. Bristle of *Eteone picta*, De Quatref. × about 700.
23. 23 *a*, and 23 *b*. Bristles of *Phyllodoce maculata*, L. × Zeiss oc. 2, obj. F., and draw-tube, full.
24. Long swimming bristle (spiral) of male *Phyllodoce maculata*, L., in July. × Zeiss oc. 4, obj. D.

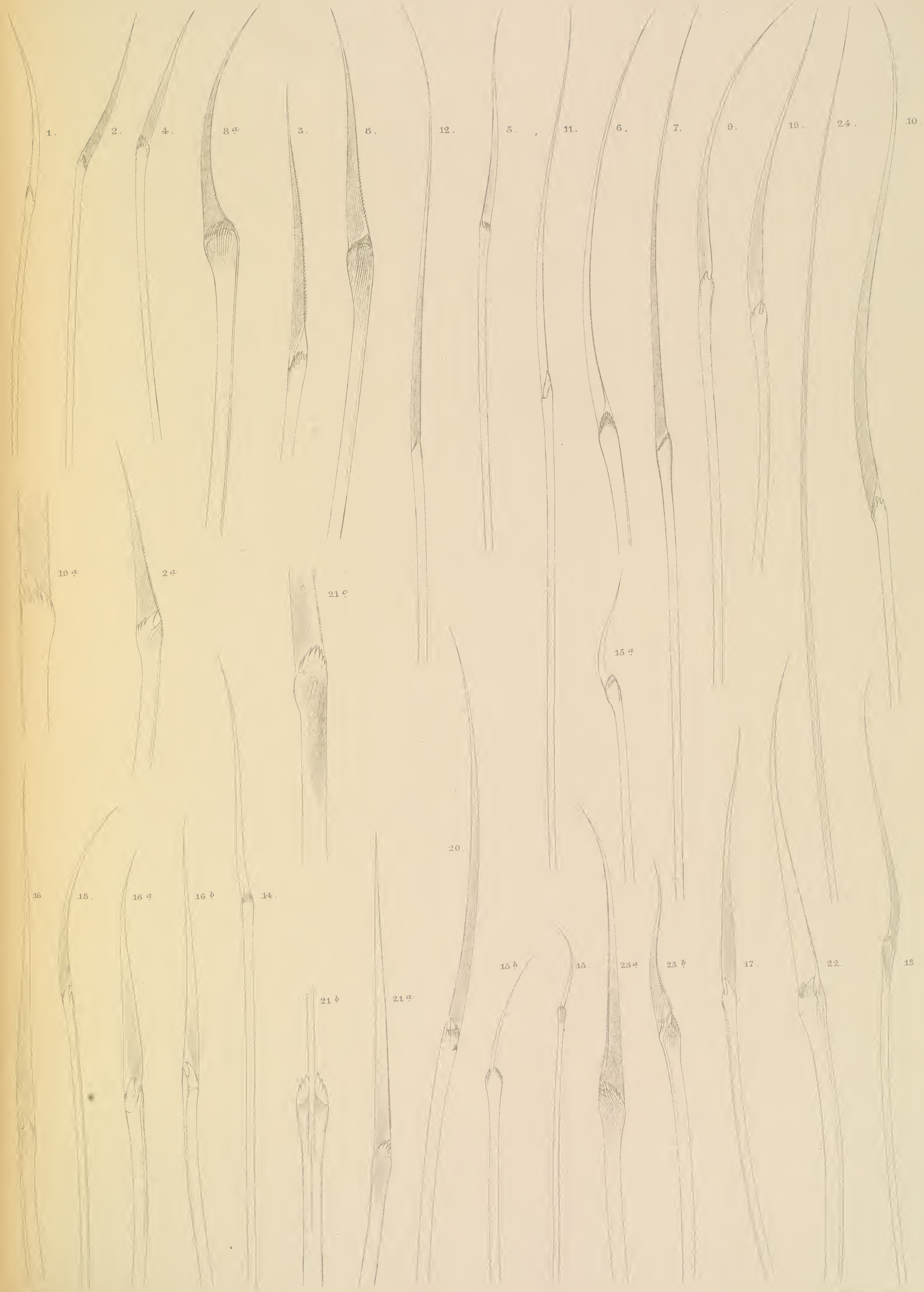

1.
2.
4.
8 a
3.
8.
12.
5.
11.
6.
7.
9.
19.
24.
10.
19 a
2 a
21 c
15 a
16.
18.
16 a
16 b
14.
20.
15 b
15.
23 a
23 b
17.
22.
13.
21 b
21 a

PLATE LXXIX.

Fig.

1. Portion of shaft of bristle from the dorsal lobe of *Ophiodromus flexuosus*, D. Chiaje. × 750.

1 *a*. Bristle with longest terminal process from the same. × Zeiss oc. 2, obj. F.

1 *b*. Bristle with shorter terminal piece. × 700.

2. Dorsal bristle of *Castalia punctata*, O. F. Müll. × Zeiss oc. 2, obj. F.

2 *a*. Ventral bristle of the foregoing. × Zeiss oc. 2, obj. F.

2 *b*. Bristle with shorter terminal region from the same. × 700.

3. Ventral bristle of *Castalia arctica*, Mgrn., from south-west Ireland. × Zeiss oc. 2, obj. D.

3 *a*. Tip of bristle, more highly magnified.

4. Tip of shaft and terminal piece of the bristle of *Castalia fusca*, Johnst. × 700.

5. Bristle of *Leocrates atlantica*, Roule, with short tip. × about 100.

5 *a*. Tip of a bristle (terminal piece). × about 400.

6. Tip of terminal piece of similar bristle in *Leocrates Claparedii*, for comparison. × about 400.

7. Tip of bristle of *Dalhousiella Carpenteri*, McI. × about 400.

8. Bristle of *Magalia perarmata*, De St. Jos. × Zeiss oc. 2, obj. D.

8 *a*. Another of the same with longer tip. × Zeiss oc. 2, obj. D.

9. Bristle of *Pionosyllis* (*Syllis*) *hyalina*, Grube. × Zeiss oc. 4, obj. F.

9 *a*. Simple bristle in the posterior segments of the same. × Zeiss oc. 4, obj. C.

10. Bristle of *Xenosyllis Kinbergi*, McI. × Zeiss oc. 2, obj. D., with draw-tube.

11 *a* and *b*. Compound bristles of *Sphærosyllis hystrix*, Clap. × Zeiss oc. 4, obj. F.

12. Simple bristle of the foregoing. × Zeiss oc. 2, obj. D, and draw-tube.

13. Long swimming bristles of the same. × Zeiss oc. 2, obj. F.

14. Bristle of *Pionosyllis prolifera*, Krohn, from Scalloway, with long tip. × Zeiss oc. 2, obj. D.

14 *a*. Another example of the foregoing with slightly shorter tip. × Zeiss oc. 2, obj. D.

14 *b*. Bristle from a bud of the same species dredged at Scalloway. × Zeiss oc. 2, obj. D.

14 *c* and 14 *c'*. Bristles of *Pionosyllis prolifera* var. *Malmgreni*. × 700.

15. Bristle of the same form with shorter (average) tip from Guernsey. × Zeiss oc. 4, obj. F.

16. Bristle of the foregoing from Luccomb Chine, with less distinctly bifid tip. × Zeiss oc. 4, obj. F.

17, 17 *a* and 17 *b*. Bristles of *Pionosyllis divaricata*, Keferst. × Zeiss oc. 4, obj. F.

18. Bristle of *Trypanosyllis zebra*, Grube. × Zeiss oc. 2, obj. F, draw-tube, full.

1 a.

1.

1 b

2.

2 a.

2 b.

3.

3 a.

4.

5.

7.

6.

5 a.

17 a.

15.

16.

11 a.

11 b.

14 c.

14 c.'

9 a.

8.

8 a.

14.

12.

14 b.

18.

10.

14 a.

17 b.

13.

9.

W.C.M.& A.H.W. del.

f.a P.W.M.Trap impr.

PLATE LXXX.

Fig.

1. Bristle of *Eusyllis tubifex*, Gosse. × Zeiss oc. 2, obj. D.
2. Bristle of *Eusyllis Blomstrandi*, Mgrn. × Zeiss oc. 2, obj. D.
3. Bristle of *Autolytus A* (referred to on p. 222 of vol. ii, Part I). × Zeiss oc. 2, obj. D.
4. Bristle of *Odontosyllis fulgurans*, Clap. × Zeiss oc. 2, obj. D.
5. Peculiar tip of spine from the posterior segments of *Odontosyllis ctenostoma*, Clap., from Plymouth. × Zeiss oc. 2, obj. D.
6. Bristle of *Odontosyllis ctenostoma*. × Zeiss oc. 2, obj. F., with 3-in. draw-tube.
7. Bristle of *Odontosyllis gibba*, Clap., var. *Robertiana*, dredged off St. Peter Port, Guernsey. × Zeiss oc. 2, obj. D.
8. Bristles of *Syllis armillaris*, O. F. M. × 280.

8 *a*.[1] Posterior bristle of the foregoing. × 350.

9 and 9 *a*. Simple and compound bristles of *Ioida macrophthalma*, Johnst. × 350.

10. Bristle of *Syllis cornuta*, H. Rathke, var. *Collingsii*, off Sark. The bifid tip is not very distinct in this figure. × Zeiss oc. 2, obj. D.
11. Bristles (two) of *Syllis cucullata*, McI., from Luccomb Chine. × Zeiss oc. 2, obj. D.
12. Compound bristle of *Syllis Krohnii*, Ehlers, from Lochmaddy. × 700.
13. Compound bristle of *Syllis macroceras*, Grube, Isle of Wight. × Zeiss oc. 2, obj. D.

13 *a*. The same from an example from the Gouliot Caves, Sark. × Zeiss oc. 2, obj. D.

14. Compound bristle of *Syllis brevicirrata*, McI., with longer tip. × Zeiss oc. 2, obj. D.

14 *a*. A form of the same with shorter tip. × Zeiss oc. 2, obj. D.

15. Bristle (hamate) of *Syllis spongicola*, Grube. × Zeiss oc. 2, obj. D.
16 and 16′. Bristles of *Syllis cornuta*, H. Rathke, St. Magnus Bay, Shetland. × as above.

16 *a*. Bristles of *Syllis cornuta*, H. Rathke, off the Hebrides. × Zeiss oc. 2, obj. D.

16 *b* and 16 *c*. Bristles of the same procured off Donegal Bay by the 'Porcupine.' × Zeiss oc. 2, obj. D.

17. Upper anterior bristle of *Syllis gracilis*, Grube. × Zeiss oc. 2, obj. D.

17 *a*. Lower bristle from the same region. × as above.

17 *b*. Strong bristle from the posterior region of the foregoing, from Herm. × as above.

17 *c*. Similar bristle from an example from St. Andrews. × as above.

18 and 18 *a*. Bristles of *Syllis Buskii*, McI., from Guernsey. × Zeiss oc. 2, obj. D.

19. Bristle of *Syllis brevicirrata* var. *plana*, from Herm. × Zeiss oc. 2, obj. D.
20. Bristle of *Amblyosyllis lineata*, Grube. × Zeiss oc. 2, obj. D.
21. Bristles of *Autolytus pictus*, Ehlers. × 700.
22. Bristle of *Autolytus aurantiacus*, Clap. × about 700.

22 *a*. Another example seen from the front, the terminal piece being twisted. × about 700.

23. Compound bristle of *Autolytus prolifer*, O. F. M., seen obliquely. × Zeiss oc. 2, obj. D.

23 *a*. Swimming bristle of a bud. × Zeiss oc. 2, obj. D.

24. Falcate bristle of *Myrianida pinnigera*, Mont. × Zeiss oc. 2, obj. D.

24 *a*. Swimming bristle of a bud of the foregoing. × Zeiss oc. 2, obj. D.

25. Falcate bristles of the tenth foot of *Nereis pelagica*, L. × Zeiss oc. 2, obj. D.

25 *a*. Dorsal bristle of the same. × Zeiss oc. 2, obj. D.

25 *b*. Sabre-shaped bristle of the epitokous form. × Zeiss oc. 2, obj. D.

26. Bristle of *Sylline rubropunctata*, Grube. × Zeiss oc. 2, obj. C.
27. Bristle of *Phyllodoce Paretti*, De Blv. × Zeiss oc. 2, obj. C.

[1] The small bifid bristle also accidentally labelled 8 *a* in the middle of this plate pertains to *Syllis gracilis*.

E.L.& A.H.W. del.

f.a P.W.M. Trap impr.

PLATE LXXXI.

Fig.

1. Bristle with shorter tip in inferior division of the tenth foot of *Nereis cultrifera*, Grube. × Zeiss oc. 2, obj. C.

1 *a*. Dorsal bristle of the foregoing. × Zeiss oc. 2, obj. C.

2. Bristle from the dorsal division (with slender tapering tip) of *Nereis Schmardæi*, De Quatref. (*irorata*, Mgrn.). × Zeiss oc. 2, obj. D.

2 *a*. Bristle with short tip from same division. × Zeiss oc. 2, obj. D.

2 *b*. Bristle with longer tip from ventral division. × Zeiss oc. 2, obj. D.

2 *c*. Swimming bristle of the same. × Zeiss oc. 2, obj. D.

3. Dorsal bristle of *Nereis Marionii*, Aud. and Edw. × Zeiss oc. 2, obj. D.

3 *a*. Stouter bristle from the lower group of the inferior lobe of the foregoing. × Zeiss oc. 2, obj. D.

4. Dorsal bristle of *Nereis Dumerilii*, Aud. and Edw. × Zeiss oc. 4, obj. F.

4 *a*. Ventral bristle of the same. × Zeiss oc. 4, obj. F.

4 *b*. Swimming bristle of epitokous form. × Zeiss oc. 2, obj. C.

4 *c*. Ventral bristle (with short tip) of the same epitokous example. × Zeiss oc. 2, obj. C.

5. Dorsal bristle of *Nereis diversicolor*, O. F. Müll. × Zeiss oc. 2, obj. C.

5 *a*. Upper bristle of the lower ventral tuft of the same. × Zeiss oc. 2, obj. C.

5 *b*. Lower bristle of the lower ventral tuft. × Zeiss oc. 4, obj. C.

6. Dorsal bristle of *Eunereis longissima*, Johnst., var., from Bay of Tunis. × Zeiss oc. 2, obj. D.

6 *a*. Falcate bristle from the ventral lobe. × Zeiss oc. 2, obj. D.

7. Bristles of the dorsal lobe of *Nereis* (*Alitta*) *virens*, Sars; *a*, entire tip; 7 *b*, articulation viewed from behind; 7 *c*, portion of shaft. × 350.

8. Superior bristle of the anterior third of *Nereis* (*Nereilepas*) *fucata*, Savigny. × Zeiss oc. 2, obj. D.

8 *a*. Upper bristle of the inferior series with short tip. × Zeiss oc. 2, obj. D

8 *b*. Falcate bristle of the ventral series of the foregoing. × Zeiss oc. 2, obj. D.

9. Dorsal bristle of *Staurocephalus rubrovittatus*, Grube, from Herm. × Zeiss oc. 2, obj. D.

9 *a* and 9 *b*. Ventral bristles with bifid terminal pieces. × Zeiss oc. 2, obj. D.

10. Bifid dorsal bristle of *Staurocephalus Kefersteini*, McI., from Lochmaddy. × Zeiss oc. 2, obj. F.

10 *a*. Simple tapering serrated bristle below the foregoing. × Zeiss oc. 2, obj. F.

10 *b*. Falcate compound form with bifid tip (one of medium length from the middle of the group). × Zeiss oc. 2, obj. D.

11. Simple tapering dorsal bristle of *Staurocephalus ciliatus*, Keferst., from St. Peter Port, Guernsey. × Zeiss oc. 2, obj. F.

11 *a*. Bifid bristle (stout). × Zeiss oc. 4, obj. F.

11 *b*. and 11 *b'*. Compound bristles from the ventral series, with a tip of medium length. × Zeiss oc. 4, obj. F.

E.L. & A.H.W. del.

f.a P.W.M. Trap impr.

PLATE LXXXII.

Fig.

1. Dorsal bristles of *Ophryotrocha puerilis*. × Zeiss oc. 2, obj. D.

1 *a*. Ventral bristle. × Zeiss oc. 2, obj. D.

2. Dorsal bristle of *Lumbriconereis fragilis*, O. F. Müll. × Zeiss oc. 2, obj. D.

2 *a*. Winged hook of the fiftieth segment. × Zeiss oc. 2, obj. D., reduced.

2 *b*. Hook from the same foot with terminal prolongation of the guard. × Zeiss oc. 2, obj. D, reduced.

3. Dorsal winged bristle of *Lumbriconereis Latreillii*, Aud. and Edw. × Zeiss oc. 2, obj. D.

3 *a*. Articulated and winged hook from foot in front of tenth. × Zeiss oc. 2, obj. D, reduced.

3 *b*. Articulated and winged anterior hook with shorter terminal piece (behind tenth foot). × Zeiss oc. 2, obj. D., reduced.

3 *c*. Posterior hook. × Zeiss oc. 2, obj. D.

4. Long winged hook from the first foot of *Lumbriconereis impatiens*, Clap. × Zeiss oc. 2, obj. D.

4 *a*. Another example from the same foot which shows a tendency to form an articulation. × Zeiss oc. 2, obj. D.

4 *b*. Stronger dorsal bristle from fifty-seventh foot. × Zeiss oc. 2, obj. D.

4 *c*. More slender form from the same foot. × Zeiss oc. 2, obj. D.

4 *d*. Hook from the middle of the body. × Zeiss oc. 2, obj. D.

5. Winged bristle of *Lumbriconereis hibernica*, McI. × Zeiss oc. 2, obj. D, draw-tube.

5 *a*. Long, winged tapering hook from the tenth foot. × Zeiss oc. 2, obj. F.

5 *b*. The same viewed from the front so as to show both wings at the tip. × Zeiss oc. 2, obj. D.

5 *c*. Long hook from the thirtieth foot. × Zeiss oc. 2, obj. D.

5 *d*. Long hook considerably behind the foregoing. × Zeiss oc. 2, obj. D.

6. Tenth foot of *Lumbriconereis gracilis*, Grube, from Lochmaddy. × Zeiss oc. 2, obj. D.

6 *a*. Bristles from thirtieth foot of the foregoing. × Zeiss oc. 2, obj. D.

7. Tenth foot of *Lumbriconereis* G. × 200.

7 *a*. Elongated hook from the middle of the body. × Zeiss oc. 2, obj. D.

8. Dorsal bristle (above spine) of *Lumbriconereis* (*Zygolobus*) *laurentianus*, Grube. × Zeiss oc. 2, obj. D.

8 *a*. Bristle with bow-like curve below the spine. × Zeiss oc. 2, obj. D.

8 *b*. Long winged hook of the twentieth foot seen from the front. × Zeiss oc. 1, obj. D.

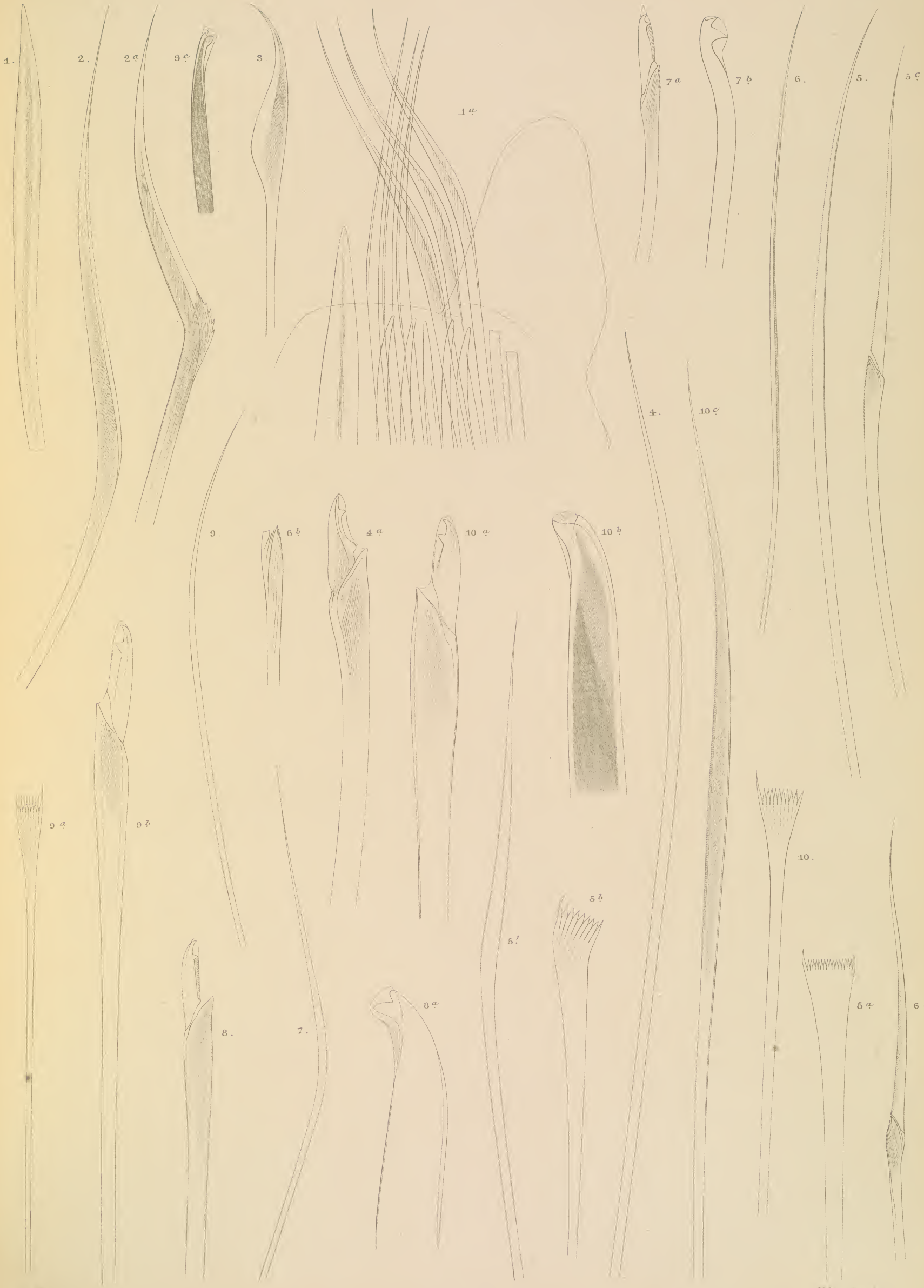
8 *c*. Profile of the same. × Zeiss oc. 1, obj. D.

1.
1 a
2 a
2.
7.
3 b
3 c
2 b
3 a
4 b
4 c
3.
4 d
5.
7 a
5 b
8.
5 a
5 d
5 c
8 a
4.
4 a
6 a
6.
8 c
8 b

PLATE LXXXIII.

Fig.

1. Spine of *Drilonereis longa*, Webst., var. *Elisabethæ*, McI. × 100.
1 *a*. Tip of foot with bristles. × Zeiss oc. 2, obj. D.
2. Dorsal bristle of *Arabella iricolor*, Mont. × Zeiss oc. 2, obj. D.
2 *a*. Bristles below the former with bold serration. × Zeiss oc. 2, obj. D.
3. Bristle of *Notocirrus scoticus*, McI. × Zeiss oc. 2, obj. D.
4. Dorsal bristle of *Eunice fasciata*, Risso. × Zeiss oc. 2, obj. D.
4 *a*. Falcate bristle. × Zeiss oc. 2, obj. D.
5. Anterior dorsal bristle of *Marphysa sanguinea*, Mont. × Zeiss oc. 2, obj. D.
5′. Another showing slightly broader tip. × Zeiss oc. 4, obj. D, with 2-in. draw-tube.
5 *a*. Brush-like bristle. × Zeiss oc. 4, obj. F.
5 *b*. Variety of the latter near the tip of the tail, slightly twisted. × Zeiss oc. 4, obj. F.
5 *c*. Ventral bristle. × Zeiss oc. 4, obj. F.
6. Dorsal bristle of *Marphysa Kinbergi*, McI., from the ‘Porcupine,’ 1870. × Zeiss oc. 2, obj. D.
6 *a*. Jointed bristle. × Zeiss oc. 4, obj. D.
6 *b*. Tip of shaft of the foregoing turned so as to exhibit its structure. × Zeiss oc. 4, obj. D.
7. Dorsal bristle of *Eunice vittata*, D. Chiaje. × Zeiss oc. 4, obj. D.
7 *a*. Falcate bristle (ventral). × Zeiss oc. 4, obj. F.
7 *b*. Great hook with a bifid crown, from Adventure Bank, ‘Porcupine,’ 1870. × Zeiss oc. 4, obj. F.
8. Falcate bristle of *Eunice norvegica*, L., from Norway. × Zeiss oc. 2, obj. D.
8 *a*. Posterior hook. × Zeiss oc. 2, obj. D.
9. Dorsal bristle of *Eunice norvegica*, var. B.A. ‘Porcupine.’ × Zeiss oc. 2, obj. D.
9 *a*. Brush-like bristle. × Zeiss oc. 2, obj. D.
9 *b*. Falcate ventral bristle. × Zeiss oc. 2, obj. F.
9 *c*. Posterior hook. × Zeiss oc. 2, obj. D.
10. Brush-like bristles of dorsal series of *Eunice floridana*, Pourt. × Zeiss oc. 2, obj. D.
10 *a*. Falcate bristle. × Zeiss oc. 4, obj. D.
10 *b*. Posterior hook. × Zeiss oc. 4, obj. D.
10 *c*. Dorsal bristle of the same. × Zeiss oc. 4, obj. D.



A. H.W. del.

f.& E.W.M.Trap Impr.

PLATE LXXXIV.

Fig.

1. Dorsal bristle of *Nematonereis unicornis*, Grube, from St. Peter Port, Guernsey. × Zeiss oc. 2, obj. D, full draw-tube.

1 *a*. Posterior hook. × 350.

1 *b*. Falcate bristle. × Zeiss oc. 4, obj. F.

1 *c*. Brush-shaped bristle from a posterior foot. Zeiss oc. 2, obj. D.

2. Dorsal bristle of *Lysidice punctata*, Risso. × Zeiss oc. 2, obj. D. with 3-in. draw-tube.

2 *a*. Falcate bristle. × Zeiss oc. 2, obj. D, with 3-in. draw-tube.

2 *a'*. Falcate bristle of the tenth foot. × Zeiss oc. 2, obj. D, with 3-in. draw-tube.

3. Falcate bristle of the first foot of *Onuphis britannica*, McI. The folds of the two wings make a complex tip. × 200.

3 *a*. Simple winged bristle from the twentieth foot. × 200.

3 *b*. Brush-like bristle from the twentieth foot. × Zeiss oc. 2, obj. F.

3 *c*. Powerful hook from the same segment. × 200.

4. Dorsal bristle of *Onuphis brevibrachiata*, Ehlers. × Zeiss oc. 2, obj. D.

4 *a*. Ventral bristle. × Zeiss oc. 2, obj. D.

4 *b*. Powerful winged hook from the twentieth foot. × Zeiss oc. 2, obj. D.

4 *c*. Brush-like bristle (anterior). × Zeiss oc. 4, obj. D.

5. Falcate bristle of first foot of *Onuphis conchylega*, Sars. Wings have been abraded. × Zeiss oc. 2, obj. D.

5 *a*. Developing bristle (in the tissues), showing wings. × Zeiss oc. 2, obj. D.

5 *b*. Dorsal bristle. × Zeiss oc. 2, obj. D.

5 *c*. Ventral hook. × Zeiss oc. 2, obj. D.

6. Bristle of the first foot of *Onuphis* (*Diopatra*) *fragosa*, Ehlers. × Zeiss oc. 2, obj. D.

6 *a*. Dorsal bristles of the twentieth foot. × Zeiss oc. 2, obj. D.

6 *b*. Ventral hook. × Zeiss oc. 2, obj. D.

7. Falcate bristle from the anterior region of *Onuphis sicula*, De Quatref. × 700.

7 *a*. Another example of the foregoing. × Zeiss oc. 2, obj. D.

7 *b* and 7 *c*. Dorsal bristles, the former with just a trace of a wing. × Zeiss oc. 2, obj. D., with draw-tube (full).

7 *d*. Posterior hook. × 700.

8. Falcate bristle of the first foot of *Hyalinœcia tubicola*, O. F. Müll. (small example). × 200.

8 *a*. Dorsal bristle (anterior region). × Zeiss oc. 2, obj. D.

8 *b*. Brush-like bristle of the same region. × Zeiss oc. 2, obj. D.

8 *c*. Powerful winged hook from the eightieth foot. × Zeiss oc. 2, obj. D.

8 *d*. Lower bristle of the dorsal series with broad wings, from the eighth foot. × Zeiss oc. 2, obj. D.

9. Hook of *Lysidice punctata*, Risso. × Zeiss oc. 2, obj. D. with draw-tube.

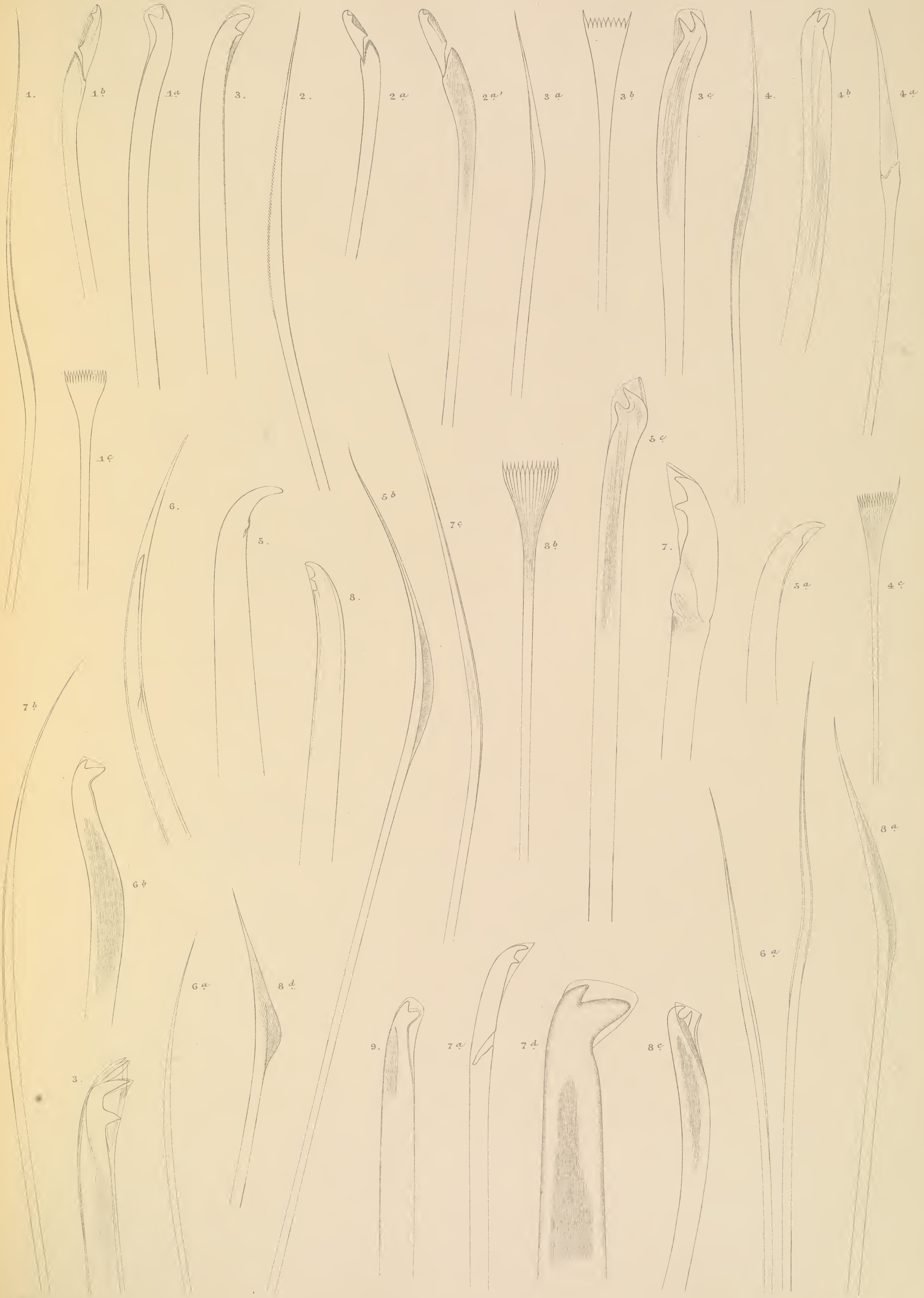

1.
1 b
1 a
3.
2.
2 a
2 a'
3 a
3 b
3 c
4.
4 b
4 a
1 c
6.
5.
5 b
7 c
8 b
5 c
7.
5 a
4 c
7 b
8.
8 a
6 b
6 a
8 d
9.
7 a
7 d
8 c
3.

PLATE LXXXV.

Fig.

1. Dorsal bristle of *Goniada maculata*, Œrst. × Zeiss oc. 2, obj. D.

1 *a*, 1 *a'*. Ventral bristles. × Zeiss oc. 2, obj. D.

2. Ventral bristle of *Glycinde Nordmanni*, Mgrn., in lateral view. × Zeiss oc. 3, obj. D, with draw-tube.

2 *a*. A form with longer tip seen from the front. × Zeiss oc. 2, obj. D, with draw-tube.

2 *b*. Dorsal bristle with process at tip. × Zeiss oc. 2, obj. D, with draw-tube.

3. Dorsal bristle of *Glycera lapidum*, De Quatref., from the 'Porcupine' (muddy sand), 1870. × Zeiss oc. 2, obj. D.

3 *a*. Ventral bristle of the ordinary kind. × Zeiss oc. 2, obj. D.

3 *b*. Larger (upper and lower) ventral bristle from the ninetieth foot. × Zeiss oc. 2, obj. D.

4. Dorsal bristles of *Glycera siphonostoma*, D. Chiaje. × 280.

4 *a* and 4 *b*. Ventral bristles. × 280.

5. Dorsal bristle of *Glycera alba*, H. Rathke, from Cape Guardia, 'Porcupine,' 1870. × Zeiss oc. 2, obj. D.

5 *a*. Ventral bristle. × Zeiss oc. 2, obj. D.

6. Dorsal bristle of *Glycera Goësi*, Mgrn., from St. Magnus Bay. × Zeiss oc. 2, obj. D, with full draw tube.

6 *a*. Ventral bristle. × Zeiss oc. 2, obj. D, with full draw-tube.

7, 7', 7''. Dorsal (camerated) bristles of *Aricia Cuvieri*, Aud. and Edw., the latter bristle in profile. × Zeiss oc. 2, obj. D.

7 *a*. Strong brownish ventral bristle. × Zeiss oc. 2, obj. D.

7 *b*. Larger example. × Zeiss oc. 2, obj. D.

8. Dorsal bristle of *Aricia Grubei*, Ehlers, from the 'Porcupine,' 1870. × Zeiss oc. 2, obj. D.

8 *a*. Stout spine-like bristle of the inferior division of the foot. × Zeiss oc. 2, obj. D.

8 *b*. Hastate spine. × Zeiss oc. 2, obj. D.

9. Lateral view of dorsal bristle (camerated) of *Aricia norvegica*, Sars. × Zeiss oc. 2, obj. D.

9 *a*. Hastate spine. × Zeiss oc. 2, obj. D.

9 *b*. Bifurcate bristle with spinous forks. × Zeiss oc. 2, obj. D.

10. Dorsal bristle of *Nainereis* sp., from St. Andrews. × Zeiss oc. 2, obj. A.

10 *a*. Tip of the same from the tenth foot. × Zeiss oc. 2, obj. D.

A.H.W. del.

Imp. P.W.M. Trap impr.

PLATE LXXXVI.

Fig.

1 and 1 *a*. Dorsal bristles of *Scoloplos armiger*, O. F. Müll. × Zeiss oc. 2, obj. D.

2. Dorsal bristle of the tenth foot of *Nainereis quadricuspida*, Fab., Lochmaddy. × Zeiss oc. 2, obj. D.

2 *a*. Somewhat clavate strong bristles (like spines) in the ventral division of the tenth foot. × Zeiss oc. 2, obj. D, with full draw-tube.

2 *b* and 2 *b'*. Dorsal bristles from the middle of the body. × Zeiss oc. 2, obj. D, with full draw-tube.

3. Simple dorsal bristle of *Marphysa Belli*, Aud. and Edw. × Zeiss oc. 2. obj. F.

3 *a*. Falcate compound bristle of *Marphysa Belli*, Aud. and Edw. × Zeiss oc. 2, obj. F.

3 *b*. Brush-shaped bristle of *Marphysa Belli*, Aud. and Edw. × Zeiss oc. 2, obj. F.

3 *c*. Compound bristle of *Marphysa Belli* with long tapering tip. It has been a little compressed at the articulation. × Zeiss oc. 2, obj. F, with 1-in. draw-tube.

3 *d*. Long ventral hook, with bifid tip, of *Marphysa Belli*, Aud. and Edw. × Zeiss oc. 2, obj. F, with 3-in. draw-tube.

4 and 4'. Dorsal bristles of *Glycera Ehlersii*, Arwid. × Zeiss oc. 4, obj. D.

4 *a*. Ventral bristles of *Glycera Ehlersii*, Arwid. × Zeiss oc. 4, obj. D.

5. Bristle of *Eulalia G.* (var. of *E. bilineata*?) from deep water off St. Andrews Bay. × Zeiss oc. 4, obj. C.

6. Bristle of *Syllis hamata*, var. *Cunninghami*. × Zeiss oc. 4, obj. C.

7. Dorsal bristle from the anterior region of *Lumbriconereis acutifrons*, McI. × Zeiss oc. 2, obj. D, with 3-in. draw-tube.

7 *a*. One of the slender series from the same region as the foregoing. × Zeiss oc. 2, obj. D, with 3-in. draw-tube.

7 *b*. Shorter winged hooks from the middle of the body of the same. × Zeiss oc. 2, obj. D, with 3-in. draw-tube.

8. Typical bristle of *Micronereis variegata*, Clap. × 700.

9. Dorsal bristle of *Leptonereis Vaillanti*, De St. Jos. × 700.

9 *a*. Ventral (heterogomph) bristle of *Leptonereis Vaillanti*, De St. Jos. × 700.

10. Long dorsal bristle of *Staurocephalus pallidus*, Langerh. × Zeiss oc. 2, obj. D.

10 *a*. Bifid dorsal bristle of *Staurocephalus pallidus*, Langerh. × Zeiss oc. 2, obj. D.

10 *b*. Ventral bristle of *Staurocephalus pallidus*, Langerh. × Zeiss oc. 2, obj. D.

11. Bristle of *Grubea clavata*, Clap. × Zeiss oc. 2, obj. D.

12. Bristle of *Pionosyllis lamelligera*, De St. Jos. × Zeiss oc. 2, obj. D.

13. Bristle of *Pionosyllis alternosetosa*, De St. Jos. × Zeiss oc. 2, obj. D.

14. Bristle of *Trypanosyllis cœliaca*, De St. Jos. × Zeiss oc. 2, obj. D.

15. Bristle of *Eurysyllis paradoxa*, Clap. × Zeiss oc. 2, obj. D.

16. Bristle of *Autolytus ehbiensis*, De St. Jos. × Zeiss oc. 2, obj. D.

17. Bristle of *Autolytus longiferiens*, De St. Jos. × Zeiss oc. 2, obj. D.

18. Bristle of *Autolytus inermis*, De St. Jos. × Zeiss oc. 2, obj. D.

19. Bristle of *Nainereis*, from St. Andrews (West Sands). × Zeiss oc. 2, obj. D.

A.H.W. del.

Firm. [illegible] Mayr.

PLATE LXXXVII.

Fig.

1. Tenth foot of *Aricia Grubei*, McI. × Zeiss oc. 2, obj. A.
2. Tenth foot of *Aricia norvegica*, Sars, from Bergen. × Zeiss oc. 2, obj. A.

2 *a*. Twenty-fifth foot. × Zeiss oc. 2, obj. A.

3. Head and anterior region of *Eurysyllis paradoxa*, Clap. (after Ehlers). Enlarged.
4. Tenth foot of *Scoloplos armiger*, O. F. Müll. Enlarged.

4 *a*. Twentieth foot. Enlarged.

4 *b*. Thirtieth foot, from Symbister Harbour. Enlarged.

4 *c*. Head of the foregoing. Enlarged.

5. Tenth foot of *Nainereis quadricuspida*, Fabr., from Lochmaddy, North Uist. × 21.

5 *a*. Twenty-third foot (about). × 21.

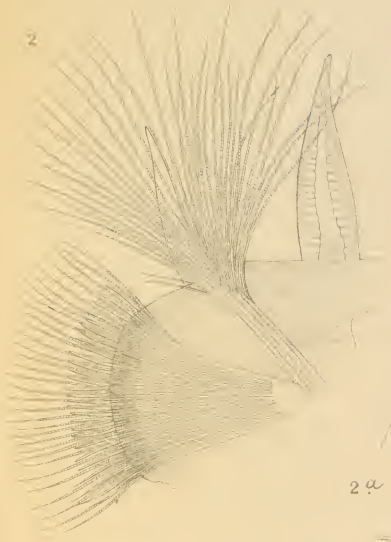
5 *b*. Posterior foot. × 21.

6. Typical foot of *Glycera Ehlersii*, Arwid., from behind. × 21.
7. Dorsal view of *Lumbriconereis acutifrons*, McI. Enlarged.
8. Tenth foot of *Aricia Edwardsi* an. var. *A. Cuvieri*. Enlarged.
9. Head of *Staurocephalus pallidus*, Langerh. Enlarged.

9 *a*. Foot of the foregoing. × 30.

10. Foot of *Grubea clavata*, Clap. × 30.
11. Foot of *Pionosyllis lamelligera*, De St. Jos. × 30.
12. Foot of *Pionosyllis alternosetosa*, De St. Jos. × 30.
13. Foot of *Trypanosyllis cœliaca*, De St. Jos. × 30.
14. Foot of *Eurysyllis paradoxa*, Clap. × 30.
15. Foot of *Autolytus ehbiensis*, De St. Jos. × 30.
16. Foot of *Autolytus longiferiens*, De St. Jos. × 30.
17. Foot of *Autolytus inermis*, De St. Jos. × 30.
18. Lateral view of *Aricia Cuvieri*, Aud. and Edw. Enlarged.
19. Ninth foot of *Aricia Armandi*, McI. × 35.
20. Twenty-third foot of the same. × 35.
21. Tenth foot of *Goniada eremita*, Aud. and Edw. × 35.

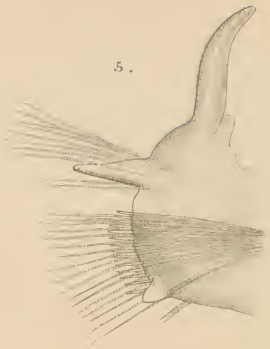
2



4 a

1.

5.

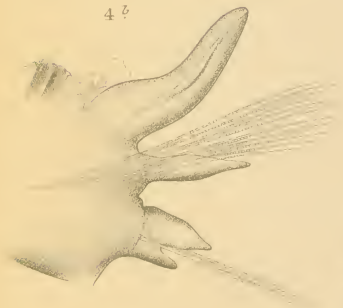


8.

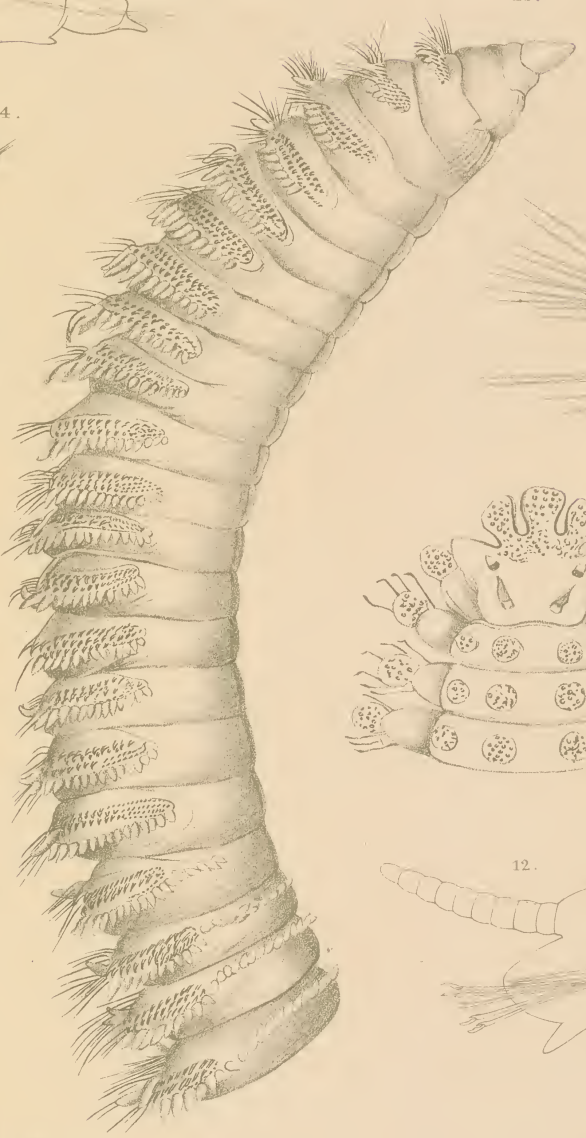
2 a

11.

4 b



18.



4.

21.

4 c

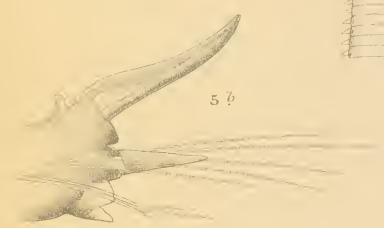
5 a

7.

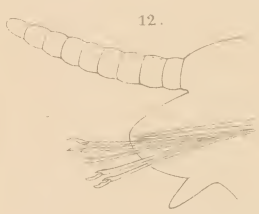
3.

20.

5 b



12.



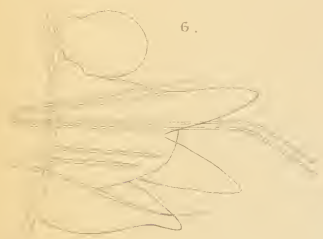
13.

10

16.

19.

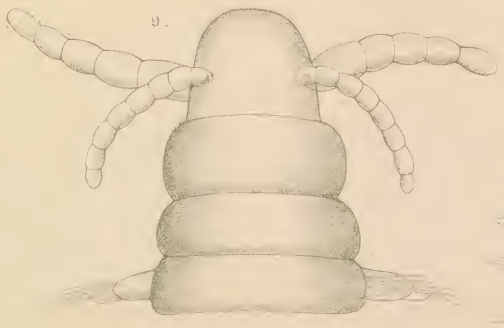
6.



17

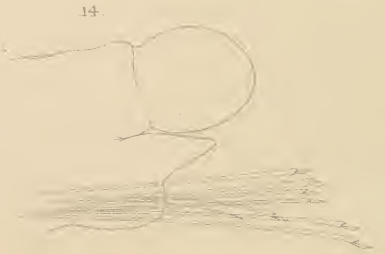
9 a

9.



15.

14



INDEX TO VOL. I.

(*Not including the Introduction.*)

	PAGE
Acanthicolepis	311
asperrima	311
Acholoë	396
astericola	397
Acoëtidæ	399
Amphinomidæ	219
Amphinomina	219
Amphiporidæ	155
Amphiporinæ	155
Amphiporus	155
bioculatus	163
hastatus	162
lactifloreus	156
pulcher	158
spectabilis	160
Anopla	181
Antinoë	365
finmarchica	368
mollis	369
Sarsi	365
Aphrodita	241
aculeata	247
Aphroditidæ	240
Borlasia	193
Elizabethæ	193
Carinella	203
annulata	203
linearis	206
Carinellidæ	203
Cephalothricidæ	208
Cephalothrix	208
linearis	208
Cerebratulus	194
angulatus	195
Enipo	395
Kinbergi	395
Enopla	155
Eunoa	291
nodosa	291
tritoni	296
Euphrosyne	233
armadillo	238
foliosa	234
Robertsoni	240
Euphrosynina	226
Eurythoë	224
borealis	224
Eusthenelais	425
hibernica	425
Evarne	353
atlantica	363
Hubrechti	360
impar	353
Johnstoni	358
Gattyana	285
cirrosa	285
Halosydna	384
gelatinosa	384
Harmothoë	313
antilopis	334
areolata	349
Fraser-Thomsoni	337
Haliaëti	336
imbricata	314
ljungmani	332
lunulata	342
marphysæ	339
setosissima	345

	PAGE
Harmathoë spinifera	327
zetlandica	330
Hermione	264
hystrix	264
Lætmatonice	258
filicornis	258
producta var. britannica	263
Lagisca	298
Elizabethæ	303
extenuata	307
floccosa	298
Jeffreysii	305
Leanira	434
hystricis	434
Lepidonotus	273
clava	280
squamatus	274
Lineidæ	181
Lineus	181
bilineatus	191
gesserensis	185
lacteus	190
marinus	181
sanguineus	188
Malmgrenia	379
andreapolis	382
castanea	379
Meckelia	202
asulcata	202
Micrura	196
aurantiaca	201
fasciolata	197
fusca	196
purpurea	200
Nemerteans	155
Nemertes	176
carcinophila	180
gracilis	176
Neesii	178
Nemertinæ	176
Panthalis	400
Œrstedi	400
Paramphinome	221
pulchella	222
Pholoë	436
minuta	437
Phyllantinoë	370
mollis	371
Polychæta	217
Polynoë	389
scolopendrina	389
Polynoidæ	270
Prosorhochmus	174
Claparedii	174
Scalisetosus	372
assimilis	377
communis	372
Sigalion	427
Buskii	431
Mathildæ	427
Sigalionidæ	406
Spinther	227
miniaceus	232
oniscoides	230
Sthenelais	407
atlantica	415
boa	408
Jeffreysii	421
limicola	417
? sp.	424
zetlandica	414
Tetrastemma	164
candida	167
dorsalis	172
flavida	170
melanocephala	165
Robertianæ	166
vermicula	169
Valencinia	207
lineformis	207

ADLARD AND SON, IMPR., LONDON AND DORKING.

RAY SOCIETY.

(INSTITUTED 1844.)

OFFICERS AND COUNCIL,

1910–11.

President:

THE RIGHT HON. LORD AVEBURY, P.C., D.C.L., LL.D., F.R.S., PRES.S.A., F.L.S., F.G.S., F.Z.S.

Vice-Presidents:

SIR CHARLES ELIOT, M.A., D.C.L., LL.D., K.C.M.G., C.B., F.Z.S., F.R.G.S.
B. DAYDON JACKSON, PH.D., F.L.S.
S. F. HARMER, M.A., F.R.S., V.P.Z.S.

Council:

ROBERT ADKIN, F.E.S.
G. T. BETHUNE-BAKER, F.L.S., F.E.S.
Rev. C. R. N. BURROWS, F.E.S.
T. A. CHAPMAN, M.D., F.Z.S.
Rev. ALFRED FULLER, M.A., F.E.S.
A. E. GIBBS, F.L.S., F.E.S., F.R.H.S.
ALBERT H. JONES, Treas.E.S.
HENRY LAVER, M.R.C.S.
G. B. LONGSTAFF, M.D., F.E.S.
EDWARD MEYRICK, B.A., F.R.S., F.Z.S., F.E.S.
A. D. MICHAEL, F.L.S., F.Z.S., F.R.M.S., F.R.H.S.
CHARLES OLDHAM, F.Z.S., M.B.O.U.
ROBERT F. SCHARFF, Ph.D., B.Sc., F.L.S., F.Z.S.
CHARLES D. SOAR, F.R.M.S.

Treasurer:

F. DUCANE GODMAN, D.C.L., F.R.S., F.L.S., F.G.S., F.Z.S., F.E.S.

Secretary:

JOHN HOPKINSON, F.L.S., F.G.S., F.Z.S., F.R.M.S., F.R.MET.SOC., ASSOC.INST.C.E.,
Weetwood, Watford.

Trustees:

LORD AVEBURY; JOHN HOPKINSON; ALBERT D. MICHAEL.

PRINTED BY ADLARD AND SON, LONDON AND DORKING.

SMITHSONIAN INSTITUTION LIBRARIES

SMITHSONIAN INSTITUTION LIBRARIES

SMITHSONIAN INSTITUTION LIBRARIES
3 9088 00438534 2
nhinvz QL388.4.M15X
v. 2 A monograph of the British marine